Drive$^{IT}$ Low Voltage AC Drives

# User's Manual

## ACH550-UH HVAC Drives (1…150 Hp)

# ACH550 Drive Manuals

## GENERAL MANUALS

**ACH550-UH HVAC User's Manual (1…150 HP)**

- Safety
- Installation
- Start-Up
- Diagnostics
- Maintenance
- Technical Data

**ACH550-UH Installation Supplement (200...550 HP)**

- Safety
- Installation
- Maintenance
- Technical Data

**ACH550 Input Disconnect and Bypass Supplement (1...550 HP)**

- Safety
- Installation
- Start-Up
- Maintenance
- Technical Data

## OPTION MANUALS

(Fieldbus Adapters, I/O Extension Modules etc., manuals delivered with optional equipment)

**Relay Output Extension Module** (typical title)

- Installation
- Programming
- Fault tracing
- Technical data

BACnet is a registered trademark of ASHRAE.

CANopen is a registered trademark of CAN in Automation e.V.

ControlNet is a registered trademark of ControlNet International.

DeviceNet is a registered trademark of Open DeviceNet Vendor Association.

DRIVECOM is a registered trademark of DRIVECOM User Organization.

Ethernet is a registered trademark of Xerox Corp.

Interbus is a registered trademark of Interbus Club.

LonWorks is a registered trademark of Echelon Corp.

Metasys is a registered trademark of Johnson Controls Inc.

Modbus and Modbus Plus are registered trademarks of Schneider Automation Inc.

Profibus is a registered trademark of Profibus Trade Org.

Profibus-DP is a registered trademark of Siemens AG.

© 2004 ABB Oy. All Rights Reserved.

# Safety

**Warning! The ACH550 adjustable speed AC drive should ONLY be installed by a qualified electrician.**

**Warning! Even when the motor is stopped, dangerous voltage is present at the Power Circuit terminals U1, V1, W1 and U2, V2, W2 and, where present, UDC+, UDC-, BRK+ and BRK-.**

**Warning! Dangerous voltage is present when input power is connected. After disconnecting the supply, wait at least 5 minutes (to let the intermediate circuit capacitors discharge) before removing the cover.**

**Warning! Even when power is removed from the input terminals of the ACH550, there may be dangerous voltage (from external sources) on the terminals of the relay outputs R01...R03.**

**Warning! When the control terminals of two or more drive units are connected in parallel, the auxiliary voltage for these control connections must be taken from a single source which can either be one of the units or an external supply.**

**Warning! The ACH550-UH is not a field repairable unit. Never attempt to repair a malfunctioning unit; contact the factory or your local Authorized Service Center for replacement.**

**Warning! The ACH550 will start up automatically after an input voltage interruption if the external run command is on.**

**Warning! The heat sink may reach a high temperature. See "Technical Data" on page 225.**

**Warning! If the drive will be used in a floating network, remove screws at EM1 and EM3 (Frame size R1...R4), or F1 and F2 (Frame size R5 or R6). See diagrams on page 14 and page 15 respectively.**

**Note!** For more technical information, contact the factory or your local ABB sales representative.

## Use of Warnings and Notes

**There are two types of safety instructions throughout this manual:**

- Notes draw attention to a particular condition or fact, or give information on a subject.
- Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment. They also tell you how to avoid the danger. The warning symbols are used as follows:

**Dangerous voltage warning warns of high voltage which can cause physical injury and/or damage to the equipment.**

**General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment**

# Table of Contents

***Safety***

Use of Warnings and Notes . . . . . 4

***Table of Contents***

***Installation***

Installation Flow Chart . . . . . 7
Preparing for Installation . . . . . 8
Installing the Drive . . . . . 10

***Start-Up***

HVAC Control Panel Features . . . . . 22
Start-Up . . . . . 23
Modes . . . . . 25
Application Macros . . . . . 35
Parameter Descriptions . . . . . 51

***Serial Communication – EFB***

Overview . . . . . 143
Planning . . . . . 144
Mechanical and Electrical Installation – EFB . . . . . 145
Communication Set-up – EFB . . . . . 146
Activate Drive Control Functions – EFB . . . . . 147
Feedback from the Drive – EFB . . . . . 151
Diagnostics – EFB . . . . . 153
Modbus Protocol Technical Data . . . . . 155
ABB Drives Profile Technical Data . . . . . 162
N2 Protocol Technical Data . . . . . 170
FLN Protocol Technical Data . . . . . 179
BACnet Technical Data . . . . . 192

***Serial Communication – FBA***

Overview . . . . . 193
Planning . . . . . 195
Mechanical and Electrical Installation – FBA . . . . . 196
Communication Set-up – FBA . . . . . 197
Activate Drive Control Functions – FBA . . . . . 197
Feedback from the Drive – FBA . . . . . 200
Diagnostics – FBA . . . . . 201
ABB Drives Profile Technical Data . . . . . 203
Generic Profile Technical Data . . . . . 210

***Diagnostics***

Diagnostic Displays . . . . . 212

Correcting Faults . . . . . 213
Correcting Alarms . . . . . 218

***Maintenance***

Maintenance Intervals . . . . . 221
Heatsink . . . . . 221
Main Fan Replacement . . . . . 222
Internal Enclosure Fan Replacement . . . . . 223
Capacitors . . . . . 223
Control Panel . . . . . 224

***Technical Data***

Ratings . . . . . 225
Input Power Connections . . . . . 228
Motor Connections . . . . . 232
Control Connections . . . . . 237
Efficiency . . . . . 240
Cooling . . . . . 240
Dimensions and Weights . . . . . 241
Degrees of Protection . . . . . 244
Ambient Conditions . . . . . 244
Materials . . . . . 245
Applicable Standards . . . . . 245
Liability Limits . . . . . 247

***Index***

# Installation

Study these installation instructions carefully before proceeding. **Failure to observe the warnings and instructions may cause a malfunction or personal hazard.**

**Warning! Before you begin read "Safety" on page 3.**

## Installation Flow Chart

The installation of the ACH550 adjustable speed AC drive follows the outline below. The steps must be carried out in the order shown. At the right of each step are references to the detailed information needed for the correct installation of the unit.

| Task | See |
|---|---|
| **PREPARE** for installation | **"Preparing for Installation"** on page 8. |
| **PREPARE** the Mounting Location | "Prepare the Mounting Location" on page 11. |
| **REMOVE** the front cover | "Remove Front Cover" on page 11. |
| **MOUNT** the drive | "Mount the Drive" on page 12. |
| **INSTALL** wiring | "Install the Wiring" on page 12. |
| **CHECK** installation | "Check Installation" on page 18. |
| **RE-INSTALL** the cover | "Re-install Cover" on page 18. |
| **APPLY** power | "Apply Power" on page 19. |
| **START-UP** | "Start-Up" on page 20. |

# Preparing for Installation

## Lifting the Drive

Lift the drive only by the metal chassis.

IP2040

## Unpack the Drive

1. Unpack the drive.
2. Check for any damage and notify the shipper immediately if damaged components are found.
3. Check the contents against the order and the shipping label to verify that all parts have been received.

## Drive Identification

*Drive Labels*

To determine the type of drive you are installing, refer to either:

- Serial number label attached on upper part of the chokeplate between the mounting holes.

**ACH550-UH-08A8-4**

| | |
|---|---|
| **U1** | 3~ 380...480 V |
| **I2N** | 8.8 A |
| **PN** | 4 |

**Ser. no.*2030700001***

- Type code label attached on the heat sink – on the right side of the unit cover.

| | | |
|---|---|---|
| **Input** | **U1** | 3~ 380...480 V |
| | **I1N** | 8.8 A |
| | **f1** | 48...63 Hz |
| **Output** | **U2** | 3~ 0...$U_1$V |
| | **I2N** | 8.8 A |
| | **f2** | 0...500 Hz |
| **Motor** | **PN** | 4 |

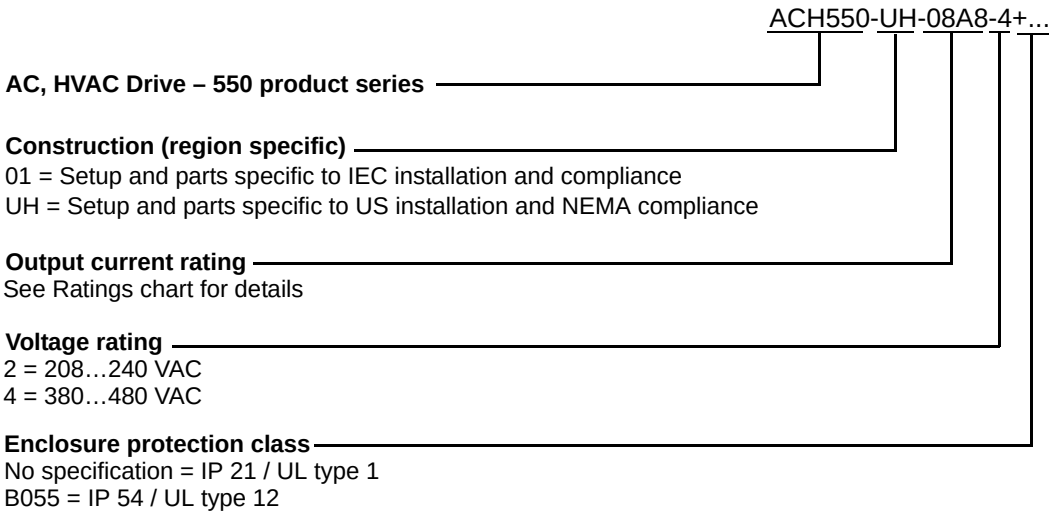
**ACH550-UH-08A8-4**

c UL us LISTED CE

**Ser. no.*2030700001***

*Type Code*

Use the following chart to interpret the type code found on either label.




*Ratings and Frame Size*

The chart in "Ratings" on page 225 lists technical specifications, and identifies the drive's frame size – significant, since some instructions in this document, vary, depending on the drive's frame size. To read the Ratings table, you need the "Output current rating" entry from the type code (see above). Also, when using the Ratings tables, note that there are two tables based on the drive's "Voltage rating".

## Motor Compatibility

The motor, drive, and supply power must be compatible:

| Motor Specification | Verify | Reference |
|---|---|---|
| Motor type | 3-phase induction motor | – |
| Nominal current | Motor value is within this range: 0.15…1.5 * $I_{2N}$ ($I_{2N}$ = normal use current) | • Type code label on drive, entry for Output $I_{2N}$, or<br>• Type code on drive and rating table in **"Technical Data"** on page 225. |
| Nominal frequency | 10…500 Hz | – |
| Voltage range | Motor is compatible with the ACH550 voltage range. | 208…240 V (for ACH550-UH-XXXX-2) or 380…480 V (for ACH550-UH-XXXX-4) |

## Tools Required

To install the ACH550 you need the following:

- Screwdrivers (as appropriate for the mounting hardware used)
- Wire stripper
- Tape measure
- Drill

- Frame Size R5 or R6 with IP 54 / UL type 12 enclosure: Punch for conduit mounting holes
- Mounting hardware: screws or nuts and bolts, four each. The type of hardware depends on the mounting surface and the frame size:

| Frame Size | Mounting Hardware | |
|---|---|---|
| R1…R4 | M5 | #10 |
| R5 | M6 | 1/4 in |
| R6 | M8 | 5/16 in |

### Suitable Environment and Enclosure

Confirm that the site meets the environmental requirements. To prevent damage prior to installation, store and transport the drive according to the environmental requirements specified for storage and transportation. See "Ambient Conditions" on page 244.

Confirm that the enclosure is appropriate, based on the site contamination level:

- IP 21 / UL type 1 enclosure. The site must be free of airborne dust, corrosive gases or liquids, and conductive contaminants such as condensation, carbon dust, and metallic particles.
- IP 54 / UL type 12 enclosure. This enclosure provides protection from airborne dust and light sprays or splashing water from all directions.

### Suitable Mounting Location

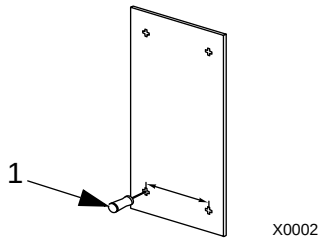
Confirm that the mounting location meets the following constraints:

- The drive must be mounted vertically on a smooth, solid surface, and in a suitable environment as defined above.
- The minimum space requirements for the drive are the outside dimensions (see "Outside Dimensions" on page 243), plus air flow space around the unit (see "Cooling" on page 240).
- The distance between the motor and the drive is limited by the maximum motor cable length. See either "Motor Connection Specifications" on page 232, or "EN61800-3 Compliant Motor Cables" on page 235.
- The mounting site must support the drive's modest weight. See "Weight" on page 242.

## Installing the Drive

**Warning! Before installing the ACH550, ensure the input power supply to the drive is off.**

### Prepare the Mounting Location




The ACH550 should only be mounted where all of the requirements defined in **"Preparing for Installation"** on page 8 are met.

1. Mark the position of the mounting holes.
2. Drill holes of appropriate size.

---

**Note!** Frame sizes R3 and R4 have four holes along the top. Use only two. If possible, use the two outside holes (to allow room to remove the fan for maintenance).

---

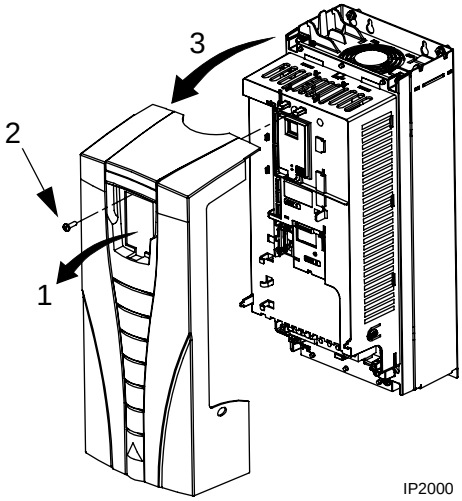
---

**Note!** ACH400 drives can be replaced using the original mounting holes. For R1 and R2 frame sizes, the mounting holes are identical. For R3 and R4 frame sizes, the inside mounting holes on the top of ACH550 drives match ACH400 mounts.

---

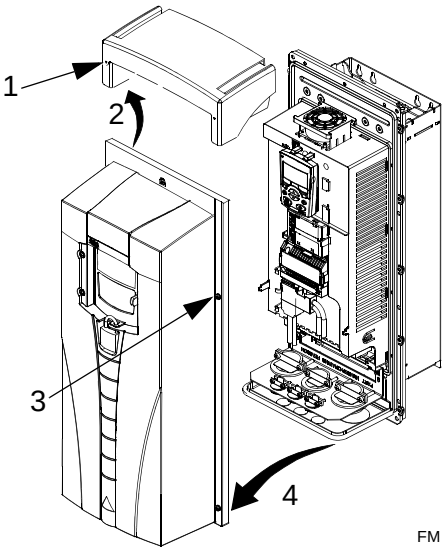
### Remove Front Cover

*IP 21 / UL Type 1*




1. Remove the control panel, if attached.
2. Loosen the captive screw at the top.
3. Pull near the top to remove the cover.

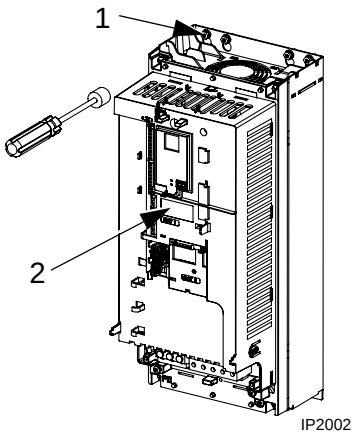
*IP 54 / UL Type 12*




1. If hood is present: Remove screws (2) holding the hood in place.
2. If hood is present: Slide hood up and off of the cover.
3. Loosen the captive screws around the edge of the cover.
4. Remove the cover.

### Mount the Drive

*IP 21 / UL Type 1*



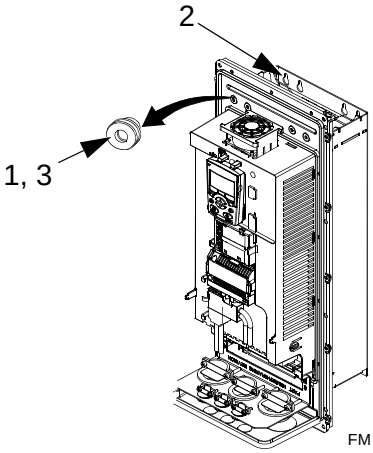

1. Position the ACH550 onto the mounting screws or bolts and securely tighten in all four corners.

   **Note!** Lift the ACH550 by its metal chassis.

2. Non-English speaking locations: Add a warning sticker in the appropriate language over the existing warning on the top of the module.

*IP 54 / UL Type 12*

For the IP54 / UL Type 12 enclosures, rubber plugs are required in the holes provided for access to the drive mounting slots.




1. As required for access, remove the rubber plugs. Push plugs out from the back of the drive.
2. Position the ACH550 onto the mounting screws or bolts and securely tighten in all four corners.

   **Note!** Lift the ACH550 by its metal chassis.

3. Re-install the rubber plugs.
4. Non-English speaking locations: Add a warning sticker in the appropriate language over the existing warning on the top of the module.

### Install the Wiring

*Conduit Kit*

Wiring drives with the IP 21 / UL type 1 Enclosure requires a conduit kit with the following items:

- conduit box
- screws
- cover

The kit is included with IP 21 / UL type 1 Enclosures.

*Wiring Overview*

**Warning! Ensure the motor is compatible for use with the ACH550. The ACH550 must be installed by a competent person in accordance with the considerations defined in "Preparing for Installation" on page 8. If in doubt, contact your local ABB sales or service office.**

As you install the wiring, observe the following:

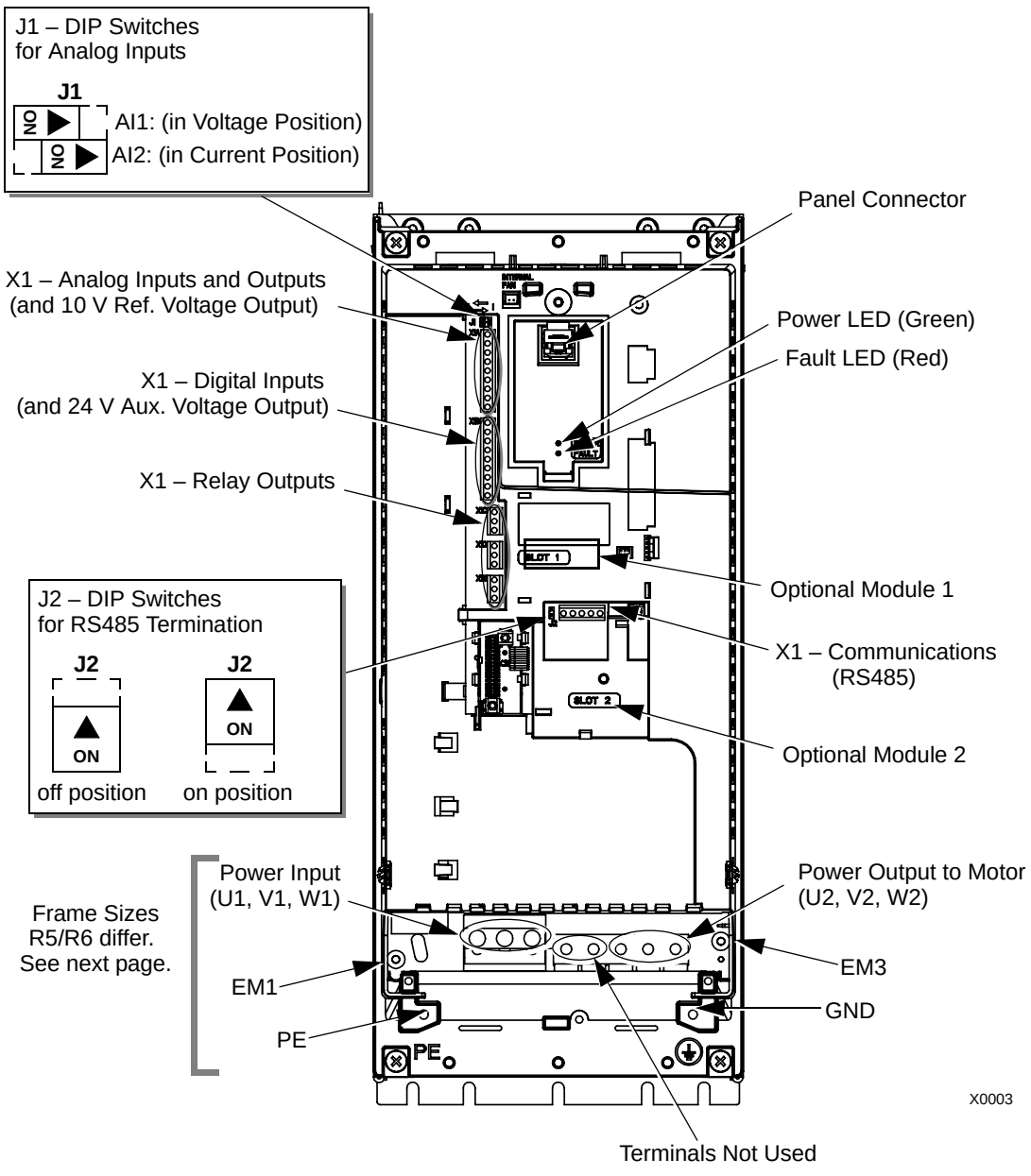
- There are two sets of wiring instructions – one set for each enclosure type (IP 21 / UL type and IP 54 / UL type 12). Be sure to select the appropriate procedure.
- For the power connection points on the drive see the "Connection Diagrams" section below.
- Use separate conduit runs to keep these three classes of wiring apart:
  - Input power wiring.
  - Motor wiring.
  - Control/communications wiring.
- For details on power connections, refer to the following sections in **"Technical Data"**:
  - "Input Power Connections" on page 228.
  - "Motor Connections" on page 232.
- For floating networks (also known as IT, ungrounded, or high impedance networks):
  - Disconnect the internal RFI filter by removing both the EM1 and EM3 screws (frame sizes R1…R4, see page 14), or F1 and F2 screws (frame sizes R5…R6, see page 15).
  - Do NOT install an external filter, such as one of the kits listed in the filter table on 236. Using an EMC/RFI filter grounds the input power through the filter capacitors, which could be dangerous and could damage the unit.
  - Where EMC requirements exist, check for excessive emission propagated to neighboring low voltage networks. In some cases, the natural suppression in transformers and cables is sufficient. If in doubt, use a supply transformer with static screening between the primary and secondary windings.
- For details on control connections, refer to the following sections:
  - "Control Connections" on page 237.
  - "Application Macros" starting on page 35.
- For electro-magnetic compliance (EMC), follow local codes and the requirements in "Motor Cable Requirements for CE & C-Tick Compliance" on page 234. For example:
  - Properly ground the wire screen cable shields.
  - Keep individual un-screened wires between the cable clamps and the screw terminals as short as possible.
  - Route control cables away from power cables.

*Connection Diagrams*

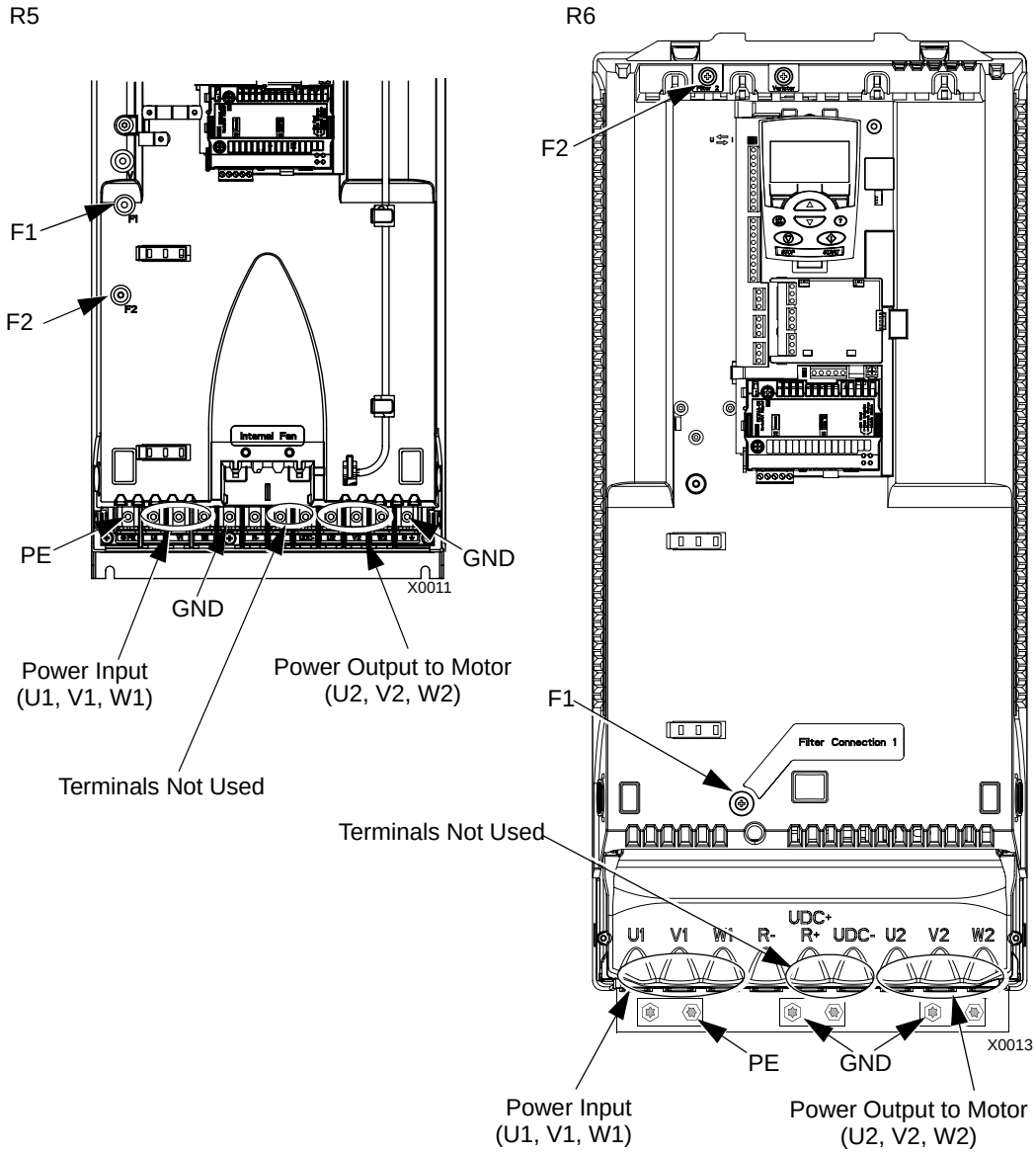
The layout of connection terminals is similar for all frame sizes (R1...R6). The only significant layout difference is in the power and ground terminals for frame sizes R5 and R6. The following diagrams show:

- Terminal layout for frame size R3, which, in general, applies to all frame sizes except as noted above.
- Power and ground terminal layout for frame sizes R5 and R6.

**R1…R4** (Diagram shows the R3 frame.)



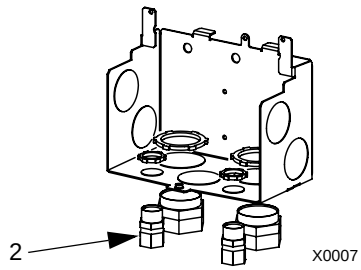

**Warning! For floating (ungrounded) networks remove screws at EM1 and EM3.**



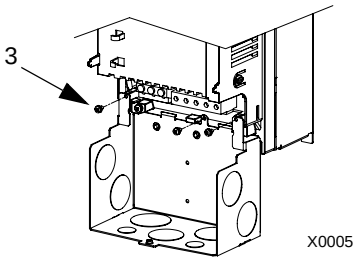

**Warning! For floating (ungrounded) networks remove screws at F1 and F2.**

*Wiring IP 21 / UL Type 1 Enclosure*

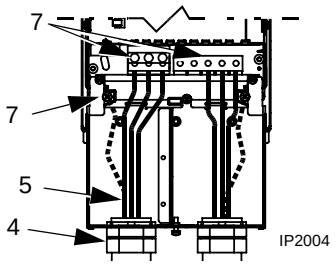
1. Open the appropriate knockouts in the conduit box. (See "Conduit Kit" above.)
2. Install thin-wall conduit clamps (not supplied).



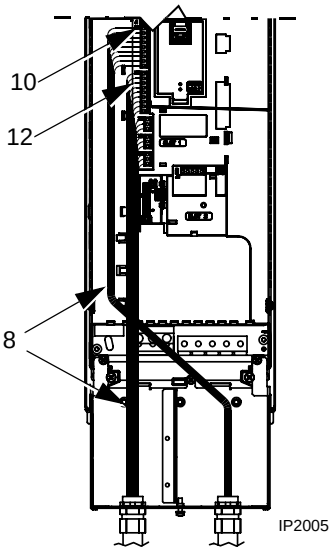

3. Install conduit box.
4. Connect conduit runs for input power, motor and control cables to the box.




5. Route input power and motor wiring through separate conduits.
6. Strip wires.
7. Connect power, motor, and ground wires to the drive terminals. See "Wiring Overview" on page 13.

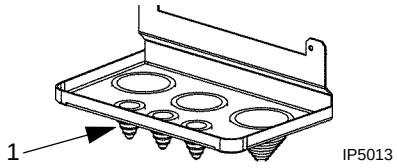


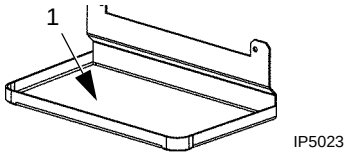

8. Route the control cables through the conduit (not the same conduit as either input power or motor wiring).
9. Strip the control cable sheathing and twist the copper screen into a pig-tail.
10. Connect the ground screen pig-tail for digital and analog I/O cables at X1-1. (Ground only at drive end.)
11. Connect the ground screen pig-tail for RS485 cables at X1-28 or X1-32. (Ground only at drive end.)
12. Strip and connect the individual control wires to the drive terminals. See "Wiring Overview" on page 13.
13. Install the conduit box cover (1 screw).



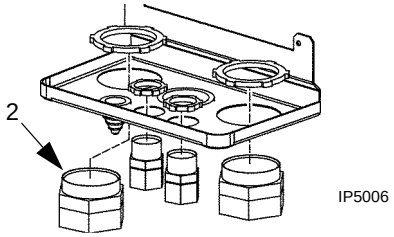
*Wiring IP 54 / UL Type 12 Enclosure*

1. Step depends on Frame Size:
   - Frame Sizes R1…R4: Remove and discard the cable seals where conduit will be installed. (The cable seals are cone-shaped, rubber seals on the bottom of the drive.)
   - Frame Sizes R4 and R5: Use punch to create holes for conduit connections as needed.

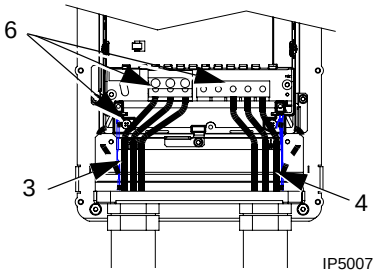


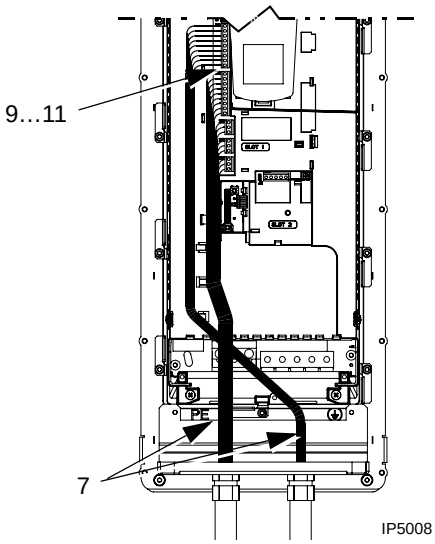

2. For each conduit run (input power, motor and control wiring must be separate), install water tight conduit connectors (not supplied).




3. Route the power wiring through conduit.
4. Route the motor wiring through conduit (not the same conduit as input power wiring run).
5. Strip the wires.
6. Connect the power, motor, and ground wires to the drive terminals. See "Wiring Overview" on page 13, and "Connection Diagrams" on page 14.




7. Route the control cables through the conduit (not the same conduit as either input power or motor wiring runs).
8. Strip the control cable sheathing and twist the copper screen into a pig-tail.
9. Connect the ground screen pig-tail for digital and analog I/O cables at X1-1. (Ground only at drive end.)
10. Connect the ground screen pig-tail for RS485 cables at X1-28 or X1-32. (Ground only at drive end.)
11. Strip and connect the individual control wires to the drive terminals. See "Wiring Overview" on page 13.
12. Install the conduit box cover (1 screw).



## Check Installation

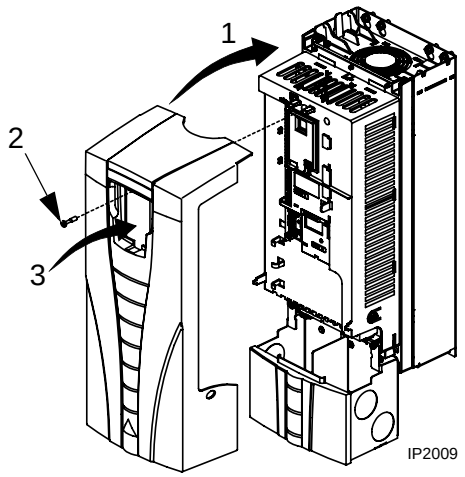
Before applying power, perform the following checks.

| ✓ | Check |
|---|---|
| | Installation environment conforms to the drive's specifications for ambient conditions. |
| | The drive is mounted securely. |
| | Space around the drive meets the drive's specifications for cooling. |
| | The motor and driven equipment are ready for start. |
| | For floating networks: The internal RFI filter is disconnected. |
| | The drive is properly grounded. |
| | The input power voltage matches the drive nominal input voltage range. |
| | The input power connections at U1, V1, and W1 are connected and tightened as specified. |
| | The input power branch circuit protection is installed. |
| | The motor connections at U2, V2, and W2 are connected and tightened as specified. |
| | The input power, motor and control wiring are routed through separate conduit runs. |
| | NO power factor compensation capacitors are in the motor cable. |
| | The control connections are connected and tightened as specified. |
| | NO tools or foreign objects (such as drill shavings) are inside the drive. |
| | NO alternate power source for the motor (such as a bypass connection) is connected – no voltage is applied to the output of the drive. |

## Re-install Cover

*IP 21 / UL Type 1*

1. Align the cover and slide it on.
2. Tighten the captive screw.
3. Re-install the control panel.

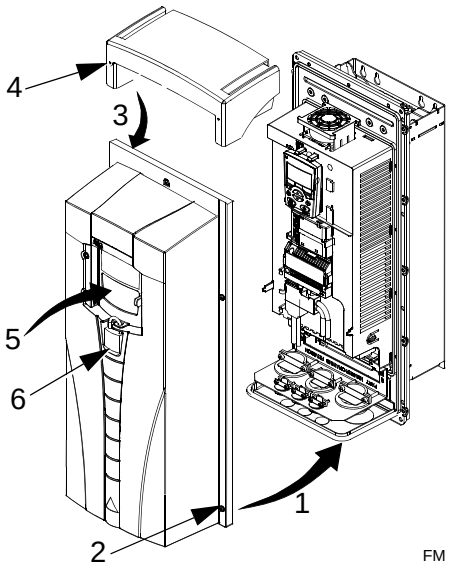


*IP 54 / UL Type 12*

1. Align the cover and slide it on.
2. Tighten the captive screws around the edge of the cover.
3. Slide the hood down over the top of the cover.
4. Install the two screws that attach the hood.
5. Re-install the control panel.

**Note!** The control panel window must be closed to comply with IP 54/UL type 12.

6. Optional: Add a lock (not supplied) to secure the control panel window.




**Apply Power**

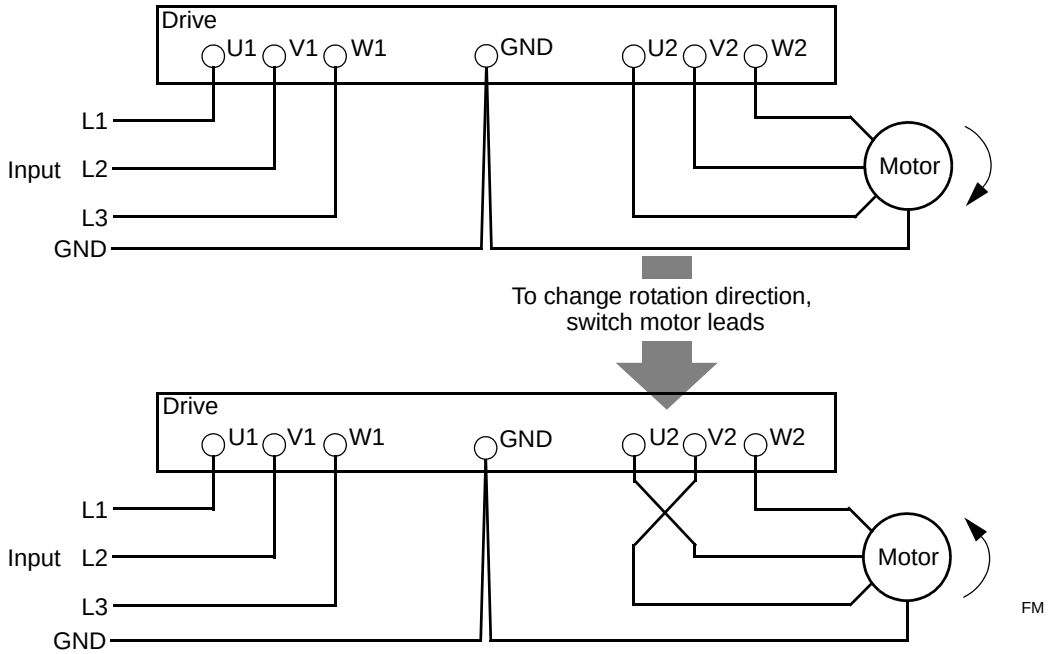
Always re-install the front cover before turning power on.

**Warning! The ACH550 will start up automatically at power up, if the external run command is on.**

1. Apply input power.

   When power is applied to the ACH550, the green LED comes on.

**Note!** Before increasing motor speed, check that the motor is running in the desired direction.To change rotation direction, switch motor leads as shown below.



**Start-Up**

The ACH550 has default parameter settings that are sufficient for many situations. However, review the following situations. Perform the associated procedures as appropriate.

*Spin Motor*

When first installed and started the control panel displays a welcome screen with the following options.

- Press Exit to commission the drive as described in section "Start-Up by Changing the Parameters Individually" on page 23.
- Press Enter to move to the following options:
  - Select "Commission Drive" to commission the drive as described in section "Start-Up by Using the Start-Up Assistant" on page 23.
  - Select "Spin Motor" to operate the motor prior to commissioning. This option operates the motor without any commissioning, except entry of the motor data as described below. Spin Motor is useful, for example, to operate ventilation fans prior to commissioning.

---

**Note!** When using Spin Motor, the motor speed is limited to the range 1/3…2/3 of maximum speed. Also, no interlocks are activated. Finally, once the drive is commissioned, the welcome screen and this option no longer appear.

---

*Motor Data*

The motor data on the ratings plate may differ from the defaults in the ACH550. The drive provides more precise control and better thermal protection if you enter the rating plate data.

1. Gather the following from the motor ratings plate:
   - Voltage
   - Nominal motor current
   - Nominal frequency
   - Nominal speed
   - Nominal power
2. Edit parameters 9905…9909 to the correct values.
   - Assistant Control Panel: The Start-up Assistant walks you through this data entry (see page 27).
   - Basic Control Panel: Refer to "Parameters Mode" on page 26, for parameter editing instructions.

*Macros*

---

**Note!** Selecting the appropriate macro should be part of the original system design, since the control wiring installed depends on the macro used.

---

1. Review the macro descriptions in "Application Macros" on page 35. Use the macro that best fits system needs.
2. Edit parameter 9902 to select the appropriate macro. Use either of the following:
   - Use the Start-up Assistant, which displays the macro selection immediately after motor parameter setup.
   - Refer to "Parameters Mode" on page 26, for parameter editing instructions.

*Tuning – Parameters*

The system can benefit from one or more of the ACH550 special features, and/or fine tuning.

1. Review the parameter descriptions in "Parameter Descriptions" starting on page 51. Enable options and fine tune parameter values as appropriate for the system.
2. Edit parameters as appropriate.

*Fault and Alarm Adjustments*

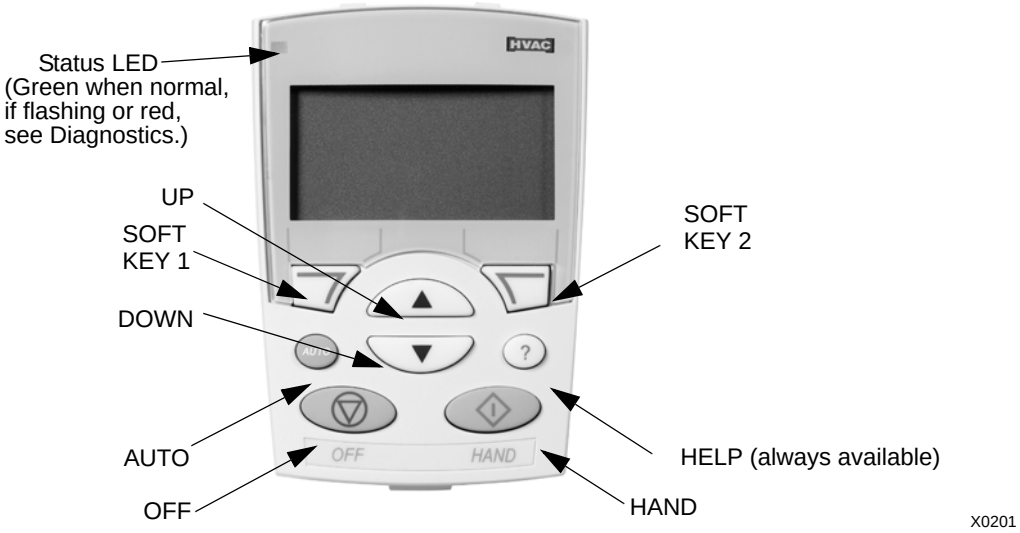
The ACH550 can detect a wide variety of potential system problems. For example, initial system operation may generate faults or alarms that indicate set-up problems.

1. Faults and alarms are reported on the control panel with a number. Note the number reported.
2. Review the description provided for the reported fault/alarm:
   - Use the fault and alarm listings on pages 213 and 218 respectively, or
   - Press the help key (Assistant Control Panel only) while fault or alarm is displayed.
3. Adjust the system or parameters as appropriate.

# Start-Up

## HVAC Control Panel Features

The ACH550 HVAC control panel (ACS-CP-B) features:




- Language selection for the display
- Drive connection that can be made or detached at any time
- Start-up assistant to facilitate drive commissioning
- Copy function for moving parameters to other ACH550 drives
- Backup function for saving parameter sets
- Context sensitive help
- Real-time clock

### General Display Features

*Soft Key Functions*

The soft key functions are defined by text displayed just above each key.

*Display Contrast*

To adjust display contrast, simultaneously press and or , as appropriate.

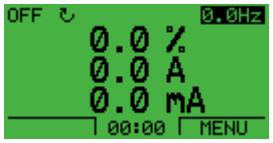
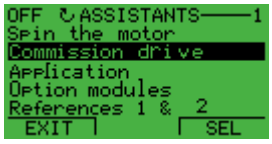
# Start-Up

Start-Up can be performed in two ways:

- Using the Start-Up Assistant.
- Changing the parameters individually.

## Start-Up by Using the Start-Up Assistant

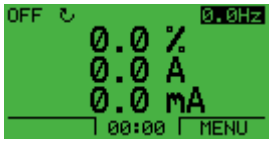
To start the Start-Up Assistant, follow these steps:

| | | | |
|---|---|---|---|
| **1** | Select MENU to enter the main menu | |  |
| **2** | Select ASSISTANTS with the Up/Down buttons and select ENTER. | | |
| **3** | Scroll to COMMISSION DRIVE with the Up/Down buttons. | |  |
| **4** | Change the values suggested by the assistant to your preferences and then press SAVE after every change. | | |

The Start-Up Assistant will guide you through the start-up.

## Start-Up by Changing the Parameters Individually

To change the parameters, follow these steps:

| | | | |
|---|---|---|---|
| **1** | Select MENU to enter the main menu. | |  |
| **2** | Select the Parameters mode with the UP/DOWN buttons and select ENTER to select the Parameters mode. | | |
| **3** | Select the appropriate parameter group with the UP/DOWN buttons and select SEL | | |

| | | | |
|---|---|---|---|
| **4** | Select the appropriate parameter in a group with the UP/DOWN buttons.Select EDIT to change the parameter value. | | |
| **5** | Press the UP/DOWN buttons to change the parameter value. | | |
| **6** | Select SAVE to store the modified value or select CANCEL to leave the set mode. Any modifications not saved are cancelled. | | |
| **7** | Select EXIT to return to the listing of parameter groups, and again to return to the main menu. | | |

To complete the control connections by manually entering the parameters, see "Parameters Mode" in this section.

For detailed hardware description, see the **"Technical Data"** section.

---

**Note!** The current parameter value appears below the highlighted parameter.

---

---

**Note!** To view the default parameter value, press the UP/DOWN buttons simultaneously.

---

---

**Note!** The most typical and necessary parameters to change are parameter groups 99 Start-up data, 10 Start/Stop/Dir, 11 Reference Select, 20 Limits, 21 Start/Stop, 22 Accel/Decel, 26 Motor Control and 30 Fault Functions.

---

---

**Note!** To restore the default factory settings, select the application macro HVAC default.

---

# Modes

The HVAC control panel has several different modes for configuring, operating and diagnosing the drive. The modes are:

- **Standard display mode –** Shows drive status information and operates the drive.
- **Parameters mode –** Edits parameter values individually.
- **Start-up assistant mode –** Guides the start-up and configuration.
- **Changed parameters mode –** Shows changed parameters.
- **Drive parameter backup mode –** Stores or uploads the parameters.
- **Clock set mode –** Sets the time and date for the drive.
- **I/O settings mode –**Checks and edits the I/O settings.

## Standard Display Mode

Use the standard display mode to read information on the drive's status and to operate the drive. To reach the standard display mode, press EXIT until the LCD display shows status information as described below.

*Status Information*

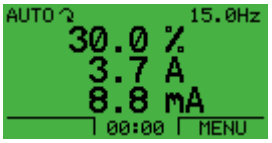
**Top**. The top line of the LCD display shows the basic status information of the drive.

- HAND **–** Indicates that the drive control is local, that is, from the control panel.
- AUTO **–** Indicates that the drive control is remote, such as the basic I/O (X1) or fieldbus.
- ↻ **–** Indicates the drive and motor rotation status as follows:

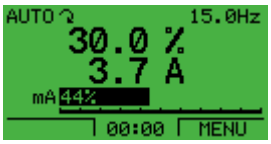
| Control panel display | Significance |
|---|---|
| Rotating arrow (clockwise or counterclockwise) | • Drive is running and at setpoint<br>• Shaft direction is forward or reverse |
| Rotating arrow blinking | Drive is running but not at setpoint |
| Stationary arrow | Drive is stopped |

- Upper right **–** shows the active reference.

**Middle**. Using parameter group 34, the middle of the LCD display can be configured to display:




- One to three parameter values **–** The default display shows parameters 0103 (OUTPUT FREQ) in percentages, 0104 (CURRENT) in amperes and 0120 (AI1) in milliamperes.
- A bar meter rather than one of the parameter values.




**Bottom.** The bottom of the LCD display shows:

- Lower corners **–** show the functions currently assigned to the two soft keys.
- Lower middle **–** displays the current time (if configured to show the time).

*Operating the Drive*

**AUTO/HAND –** The very first time the drive is powered up, it is in the auto control (AUTO) mode, and is controlled from the Control terminal block X1.

To switch to hand control (HAND) and control the drive using the control panel, press and hold the or button.

- Pressing the HAND button switches the drive to hand control while keeping the drive running.
- Pressing the OFF button switches to hand control and stops the drive.

To switch back to auto control (AUTO), press and hold the button.

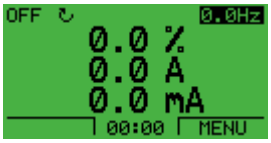
**Hand/Auto/Off –** To start the drive press the HAND or AUTO buttons, to stop the drive press the OFF button.

**Reference –** To modify the reference (only possible if the display in the upper right corner is in reverse video) press the UP or DOWN buttons (the reference changes immediately).

The reference can be modified in the local control mode, and can be parameterized (using Group 11 reference select) to also allow modification in the remote control mode.

### Parameters Mode

To change the parameters, follow these steps:

| | | | |
|---|---|---|---|
| **1** | Select MENU to enter the main menu. | |  |
| **2** | Select the Parameters mode with the UP/DOWN buttons, and select ENTER to select the Parameters mode. | | |
| **3** | Select the appropriate parameter group with the UP/DOWN buttons and select SEL | | |
| **4** | Select the appropriate parameter in a group with the UP/DOWN buttons. Select EDIT to change the parameter. | | |
| **5** | Press the UP/DOWN buttons to change the parameter value. | | |

| | | | |
|---|---|---|---|
| **6** | Select SAVE to store the modified value or select CANCEL to leave the set mode. Any modifications not saved are cancelled. | | |
| **7** | Select EXIT to return to the listing of parameter groups, and again to return to the main menu. | | |

To complete the control connections by manually entering the parameters, see "Parameters Mode" in the this section.

For detailed hardware description, see the Appendix.

---

**Note!** The current parameter value appears below the highlighted parameter.

---

---

**Note!** To view the default parameter value, press the UP/DOWN buttons simultaneously.

---

---

**Note!** The most typical and necessary parameters to change are parameter groups 99 Start-up data, 10 Start/Stop/Dir, 11 Reference Select, 20 Limits, 21 Start/Stop, 22 Accel/Decel, 26 Motor Control and 30 Fault Functions.

---

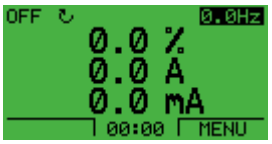
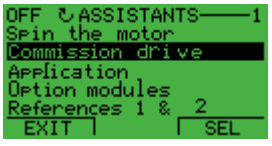
---

**Note!** To restore the default factory settings, select the application macro HVAC default.

---

### Start-Up Assistant Mode

To start the Start-Up Assistant, follow these steps:

| | | | |
|---|---|---|---|
| **1** | Select MENU to enter the main menu | |  |
| **2** | Select ASSISTANTS with the Up/Down buttons and select ENTER. | | |
| **3** | Scroll to COMMISSION DRIVE with the Up/Down buttons and select SEL. | |  |

| | | | |
|---|---|---|---|
| **4** | Change the values suggested by the assistant to your preferences and then press SAVE after every change. | | |

The Start-Up Assistant will guide you through the start-up.

The Start-Up Assistant guides you through the basic programming of a new drive. (You should familiarize yourself with basic control panel operation and follow the steps outlined above.) At the first start, the drive automatically suggests entering the first task, Language Select.The assistant also checks the values entered to prevent entries that are out of range.

The Start-Up Assistant is divided into tasks. You may activate the tasks one after the other, as the Start-Up Assistant suggests, or independently.

---

**Note!** If you want to set the parameters independently, use the Parameters mode.

---

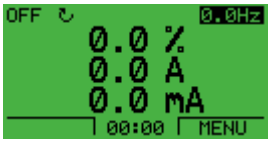
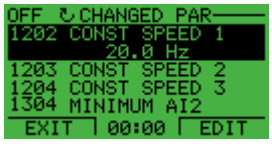
The order of tasks presented by the Start-up Assistant depends on your entries. The following task list is typical.

| Task name | Description |
|---|---|
| Spin the motor | • Prompts for control panel display language selection.<br>• Prompts for motor data.<br>• Guides user through rotation check. |
| Commission drive | Prompts for motor data. |
| Application | Prompts for application macro selection. |
| References 1 & 2 | • Prompts for the source of speed references 1 and 2.<br>• Prompts for reference limits.<br>• Prompts for frequency (or speed) limits. |
| Start/Stop Control | • Prompts for the source for start and stop commands.<br>• Prompts for start and stop mode definition.<br>• Prompts for acceleration and deceleration times. |
| Protections | • Prompts for current and torque limits.<br>• Prompts for the use of Run enable and Start enable signals.<br>• Prompts for the use of emergency stop.<br>• Prompts for Fault function selection.<br>• Prompts for Auto reset functions selection. |
| Constant Speeds | • Prompts for the use of constant speeds.<br>• Prompts for constant speed values. |
| PID Control | • Prompts for PID settings.<br>• Prompts for the source of process reference.<br>• Prompts for reference limits.<br>• Prompts for source, limits and units for the process actual value.<br>• Defines the use of Sleep function. |
| Low Noise Setup | • Prompts for switching frequency.<br>• Prompts for definition of Flux optimization.<br>• Prompts for the use of Critical speeds. |

| Task name | Description |
|---|---|
| Panel Display | Prompts for display variable and unit settings. |
| Timed Functions | Prompts for the use of Timed functions. |
| Output | • Prompts for the signals indicated through the relay outputs.<br>• Prompts for signals indicated through the analog outputs AO1 and AO2. Sets the minimum, maximum, scaling and inversion values. |

### Changed Parameters Mode

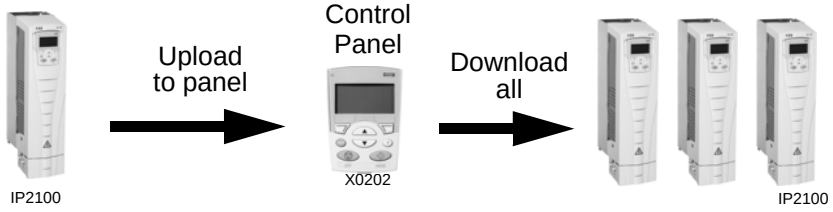
To view changed parameters, follow these steps:

| | | | |
|---|---|---|---|
| **1** | Select MENU to enter the menu. | |  |
| **2** | Select CHANGED PAR with the UP/ DOWN buttons and select ENTER. | | |
| **3** | A list of changed parameters is displayed. Select EXIT to exit the parameters mode. | |  |

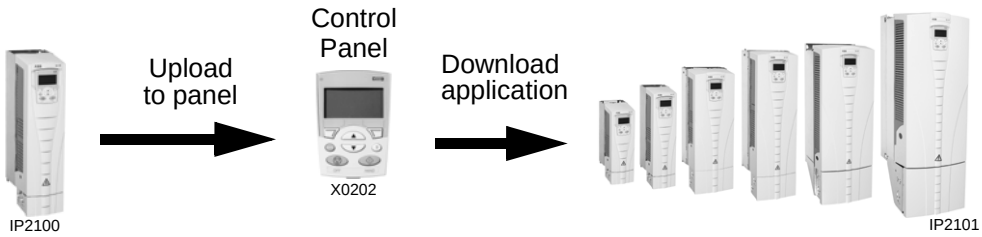
### Drive Parameter Backup Mode

Use the parameter backup mode to export parameters from one drive to another. The parameters are uploaded from a drive to the control panel and downloaded from the control panel to another drive. Two options are available:

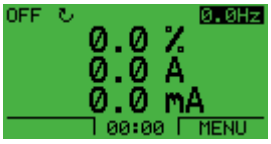
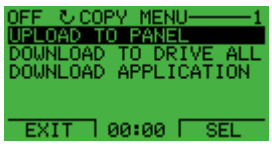
- Download all – copies all application and motor parameters to the drive. Useful where drives of the same size use the same application. Also useful to create a backup for recovery if drive parameters are corrupted or erased.



- Download application – copies only the application to the drive. Useful where drives of different sizes use the same application. Parameters 9905...9909, 1605, 1607, 5201, group 51 parameters and internal motor parameters are NOT copied.

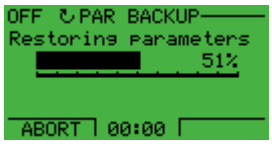
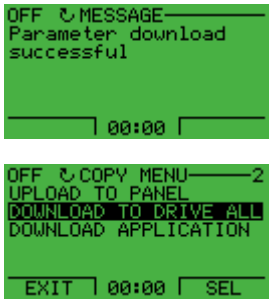



To upload parameters to control panel, follow these steps:

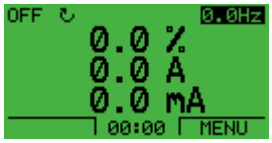
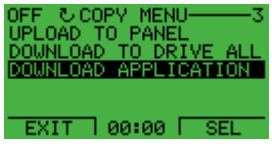
| | | | |
|---|---|---|---|
| **1** | Select MENU to enter the main menu. | |  |
| **2** | Select PAR BACKUP with the UP/ DOWN buttons and select ENTER. | | |
| **3** | Scroll to Upload to Panel and select SEL. | | |
| **4** | The text "Copying parameters" and a progress diagram is displayed. Select ABORT if you want to stop the process. | | |
| **5** | The text "Parameter upload successful" is displayed and the control panel returns to the PAR BACKUP menu. Select EXIT to return to the main menu. Now you can disconnect the panel. | | <br>  |

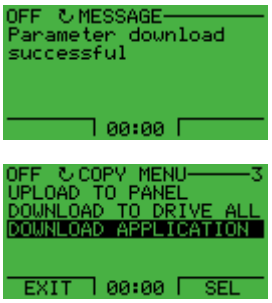
To download all parameters to drive, follow these steps:

| | | | |
|---|---|---|---|
| **1** | Select MENU to enter the menu. | | |

| | | | |
|---|---|---|---|
| **2** | Select PAR BACKUP with the UP/ DOWN buttons. | | |
| **3** | Scroll to Download to drive all and select SEL. | | |
| **4** | The text "restoring parameters" is displayed. Select ABORT if you want to stop the process. | |  |
| **5** | After the download stops, the message "Parameter download successful" is displayed and the control panel goes back to PAR BACKUP menu. Select EXIT to return to the main menu. | |  |

To download application to drive, follow these steps:

| | | | |
|---|---|---|---|
| **1** | Select MENU to enter the menu. | |  |
| **2** | Select PAR BACKUP with the UP/ DOWN buttons. | | |
| **3** | Scroll to DOWNLOAD APPLICATION and select SEL. | |  |
| **4** | The text "Downloading parameters (partial)" is displayed. Select ABORT if you want to stop the process. | | |

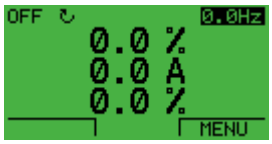
| | | | |
|---|---|---|---|
| 5 | The text "Parameter download successful" is displayed and the control panel returns to PAR BACKUP menu. Select EXIT to return to the main menu. | |  |

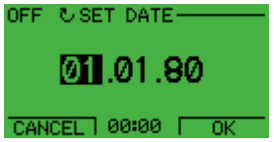
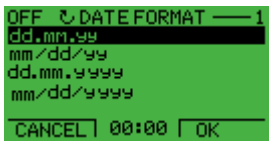
**Note!** If upload or download of parameters is aborted, the partial parameter set is not implemented.

### Clock Set Mode

The clock set mode is used for setting the time and date for the internal clock of the ACH550. In order to use the timer functions of the ACH550, the internal clock has to be set first. Date is used to determine weekdays and is visible in Fault logs.

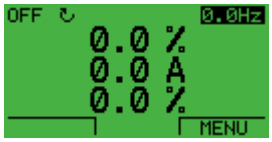
To set the clock, follow these steps:

| | | | |
|---|---|---|---|
| 1 | Select MENU to enter the main menu. | |  |
| 2 | Scroll to Clock Set with the UP/DOWN buttons and select ENTER to enter the Clock Set mode. | | |
| 3 | Scroll to Clock Visibility with the UP/ DOWN buttons and select SEL to change the visibility of the clock. | | |
| 4 | Scroll to Show Clock with the UP/DOWN buttons and select SEL to make the clock visible. | | |
| 5 | Scroll to Set Time with the UP/DOWN buttons and select SEL. | | |

| | | | |
|---|---|---|---|
| **6** | Change the hours and minutes with the UP/DOWN buttons and select OK to save the values. The active value is displayed in inverted color. | | |
| **7** | Scroll to Time Format with the UP/DOWN buttons and select SEL. | | |
| **8** | The different formats are displayed. Select a format with the UP/DOWN buttons and select SEL to confirm the selection. | | |
| **9** | Scroll to Set Date with the UP/DOWN buttons and select SEL. | | |
| **10** | Change the days, months and year with the UP/DOWN buttons and select OK to save the values. The active value is displayed in inverted color. | |  |
| **11** | Scroll to Date Format with the UP/DOWN buttons and select SEL. | | |
| **12** | The Date formats are displayed. Select a date format with the UP/DOWN buttons and select OK to confirm the selection. | |  |
| **13** | Select EXIT twice to return to the main menu. | | |

### I/O Settings Mode

To view and edit the I/O settings, follow these steps:

| | | | |
|---|---|---|---|
| **1** | Select MENU to enter the main menu. | |  |
| **2** | Scroll to I/O Settings with the UP/DOWN buttons and select ENTER. | | |
| **3** | Scroll to the I/O setting you want to view with the UP/DOWN buttons and select SEL. | | |
| **4** | Select the setting you want to view with the UP/DOWN buttons and select OK. | | |
| **5** | You can change the value with the UP/DOWN buttons and save it by selecting SAVE.<br>If you do not want to change the setting, select CANCEL. | | |
| **6** | Select EXIT to return to the main menu. | | |

# Application Macros

## Overview

Macros change a group of parameters to new, predefined values designed for specific applications. Use macros to minimize the need for manual editing of parameters. Selecting a macro sets all other parameters to their default values, except:

- Group 99: Start-up Data parameters
- The PARAMETER LOCK 1602
- The PARAM SAVE 1607
- Groups 50…52 serial communication parameters
- Group 29: Maintenance triggers

After selecting a macro, additional parameter changes can be made manually using the control panel.

Application macros are enabled by setting the value for parameter 9902 APPLIC MACRO. By default, HVAC default (value 1) is the enabled macro.

## General Considerations

The following considerations apply for all macros:

- When using a direct speed reference in AUTO mode, connect the speed reference to analog input 1 (AI1), and provide the START command using digital input 1 (DI1). In HAND/OFF mode, the control panel provides the speed reference and START command.
- When using process PID, connect the feedback signal to analog input 2 (AI2). As a default, the control panel sets the Setpoint, but analog input 1 can be used as an alternate source. You can set up process PID using parameters (Group 40) or using the PID control assistant (recommended).

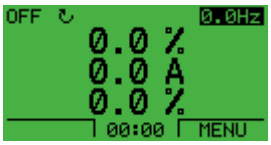
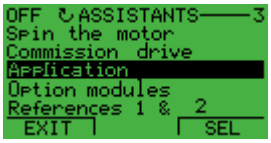
## Application / Macro Listing

This section describes the following macros:

| 9902 Value | Macro | | 9902 Value | Macro |
|---|---|---|---|---|
| 1 | HVAC default | | 8 | Internal timer |
| 2 | Supply fan | | 9 | Internal timer with constant speeds |
| 3 | Return fan | | 10 | Floating point |
| 4 | Cooling tower fan | | 11 | Dual setpoint PID |
| 5 | Condenser | | 12 | Dual setpoint PID with constant speeds |
| 6 | Booster pump | | 13 | E-bypass |
| 7 | Pump alternation | | 14 | Hand Control |

### Selecting an Application Macro

To select a macro, follow these steps:

| | | | |
|---|---|---|---|
| **1** | Select MENU to enter the main menu. | |  |
| **2** | Select ASSISTANTS with the Up/Down buttons and select ENTER. | | |
| **3** | Scroll to APPLICATION and select ENTER. | |  |
| **4** | Select a macro with the Up/Down buttons and select SAVE. | | |

### Restoring Defaults

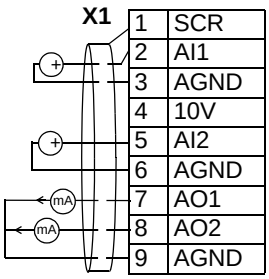
To restore the factory default settings, select the application macro HVAC Default.

### Control Wiring

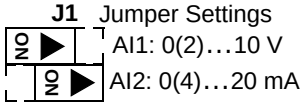
Each macro has specific requirements for control wiring. For general details about the ACH550 control wiring terminals, see “Control Terminal Descriptions” on page 238. Specific wiring requirements are included with each macro description.

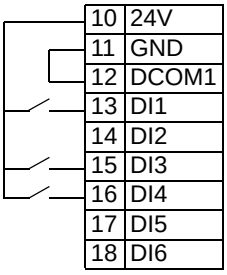
### HVAC Default

This macro provides the factory default parameter settings for the ACS550-UH. Factory defaults can be restored at any time by setting parameter 9902 to 1. The diagram below shows typical wiring using this macro. When using direct speed reference in AUTO mode or process PID, see "General Considerations" on page 35.

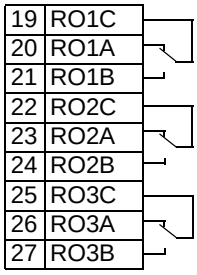


| X1 | | |
|---|---|---|
| 1 | SCR | Signal cable shield (screen) |
| 2 | AI1 | **External reference** 0(2)…10 V or 0(4)…20 mA |
| 3 | AGND | Analog input circuit common |
| 4 | 10V | Reference voltage 10 VDC |
| 5 | AI2 | **PID feedback:** 0(2)…10 V or 0(4)…20 mA |
| 6 | AGND | Analog input circuit common |
| 7 | AO1 | **Output frequency:** 0(4)…20 mA |
| 8 | AO2 | **Output current:** 0(4)…20 mA |
| 9 | AGND | Analog output circuit common |



| | | |
|---|---|---|
| 10 | 24V | Auxiliary voltage output +24 VDC |
| 11 | GND | Common for DI return signals. |
| 12 | DCOM1 | Digital input common for all |
| 13 | DI1 | **Start/Stop:** Activate to start drive |
| 14 | DI2 | Not configured |
| 15 | DI3 | **Constant (Preset) speed 1** (P 1202) |
| 16 | DI4 | **Safety interlock:** Deactivate to stop drive (P 1608) |
| 17 | DI5 | Not configured |
| 18 | DI6 | Not configured |

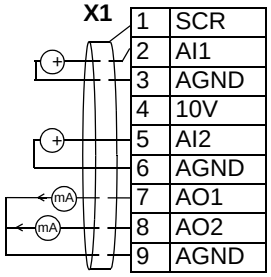


| | | |
|---|---|---|
| 19 | RO1C | Relay output 1 (P 1401) |
| 20 | RO1A | Default operation: **Ready** =>19 connected to 21 |
| 21 | RO1B | |
| 22 | RO2C | Relay output 2 (P 1402) |
| 23 | RO2A | Default operation: **Running** =>22 connected to 24 |
| 24 | RO2B | |
| 25 | RO3C | Relay output 3 (P 1403) |
| 26 | RO3A | Default operation: **Fault (-1)** =>25 connected to 27 |
| 27 | RO3B | (Fault => 25 connected to 26) |

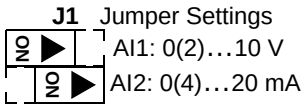
| Parameters Changed Relative to HVAC Default | | | |
|---|---|---|---|
| **Parameter** | **Value** | **Parameter** | **Value** |
| None (Default macro) | | | |

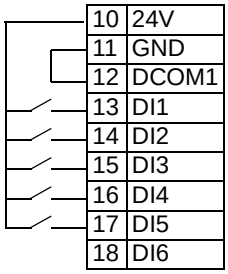
## Supply Fan

This macro configures for supply fan applications where the supply fan brings fresh air in according to signals received from a transducer. When using direct speed reference in AUTO mode or process PID, see "General Considerations" on page 35.

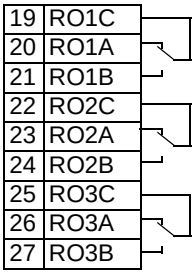



Signal cable shield (screen)
**External reference** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
Reference voltage 10 VDC
**PID feedback:** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
**Output frequency:** 0(4)…20 mA
**Output current:** 0(4)…20 mA
Analog output circuit common




Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
**Start/Stop:** Activate to start drive
**Run permissive:** Deactivate to stop drive (P 1601)
**Constant (Preset) speed 1** (P 1202[1])
**Safety interlock 1:** Deactivate to stop drive (P 1608)
**Safety interlock 2:** Deactivate to stop drive (P 1609)
Not configured




Relay output 1 (P 1401)
Default operation: **Ready** =>19 connected to 21

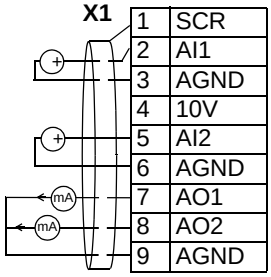
Relay output 2 (P 1402)
Default operation: **Running** =>22 connected to 24

Relay output 3 (P 1403)
Default operation: **Fault (-1)** =>25 connected to 27
(Fault => 25 connected to 26)

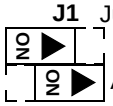
| Parameters Changed Relative to HVAC Default | | | |
|---|---|---|---|
| **Parameter** | **Value** | **Parameter** | **Value** |
| 9902 APPLIC MACRO | 2 (SUPPLYFAN) | 3207 SUPERV 3 PARAM | 0103 (OUTPUT FREQ) |
| 1401 RELAY OUTPUT 1 | 7 (STARTED) | 4001 GAIN | 0.7 |
| 1601 RUN ENABLE | 2 (DI2) | 4002 INTEGRATION TIME | 10.0 s |
| 1609 START ENABLE 2 | 5 (DI5) | 4101 GAIN | 1.0 |
| 2202 ACCELER TIME 1 | 15.0 s | 4102 INTEGRATION TIME | 60.0 s |
| 2203 DECELER TIME 1 | 15.0 s | | |

### Return Fan

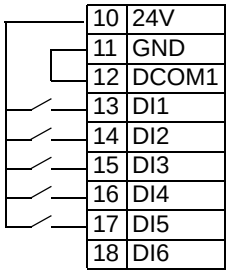
This macro configures for return fan applications where the return fan removes air according to signals received from a transducer. When using direct speed reference in AUTO mode or process PID, see "General Considerations" on page 35.



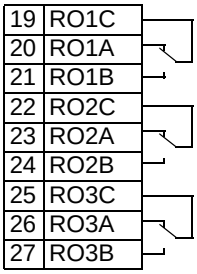

Signal cable shield (screen)
**External reference** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
Reference voltage 10 VDC
**PID feedback:** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
**Output frequency:** 0(4)…20 mA
**Output current:** 0(4)…20 mA
Analog output circuit common




Jumper Settings
AI1: 0(2)…10 V
AI2: 0(4)…20 mA




Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
**Start/Stop:** Activate to start drive
**Run permissive:** Deactivate to stop drive (P 1601)
**Constant (Preset) speed 1** (P 1202[1])
**Safety interlock 1:** Deactivate to stop drive (P 1608)
**Safety interlock 2:** Deactivate to stop drive (P 1609)
Not configured




Relay output 1 (P 1401)
Default operation: **Ready** =>19 connected to 21

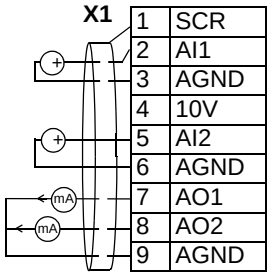
Relay output 2 (P 1402)
Default operation: **Running** =>22 connected to 24

Relay output 3 (P 1403)
Default operation: **Fault (-1)** =>25 connected to 27
(Fault => 25 connected to 26)

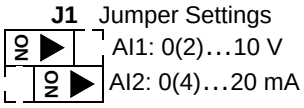
| Parameters Changed Relative to HVAC Default | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Value** | **Parameter** | | **Value** |
| 9902 | APPLIC MACRO | 3 (RETURNFAN) | 3207 | SUPERV 3 PARAM | 0103 (OUTPUT FREQ) |
| 1401 | RELAY OUTPUT 1 | 7 (STARTED) | 4001 | GAIN | 0.7 |
| 1601 | RUN ENABLE | 2 (DI2) | 4002 | INTEGRATION TIME | 10.0 s |
| 1609 | START ENABLE 2 | 5 (DI5) | 4101 | GAIN | 1.0 |
| 2202 | ACCELER TIME 1 | 15.0 s | 4102 | INTEGRATION TIME | 60.0 s |
| 2203 | DECELER TIME 1 | 15.0 s | | | |

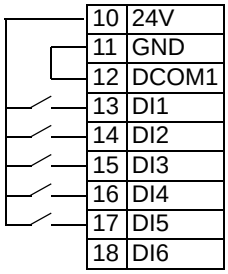
### Cooling Tower Fan

This macro configures for cooling tower fan applications where the fan speed is controlled according to the signals received from a transducer. When using direct speed reference in AUTO mode or process PID, see "General Considerations" on page 35.

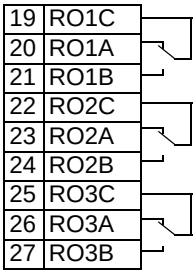



Signal cable shield (screen)
**External reference** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
Reference voltage 10 VDC
**PID feedback:** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
**Output frequency:** 0(4)…20 mA
**Output current:** 0(4)…20 mA
Analog output circuit common




Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
**Start/Stop:** Activate to start drive
**Run permissive:** Deactivate to stop drive (P 1601)
**Constant (Preset) speed 1** (P 1202[1])
**Safety interlock 1:** Deactivate to stop drive (P 1608)
**Safety interlock 2:** Deactivate to stop drive (P 1609)
Not configured




Relay output 1 (P 1401)
Default operation: **Ready** =>19 connected to 21

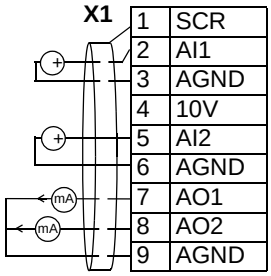
Relay output 2 (P 1402)
Default operation: **Running** =>22 connected to 24

Relay output 3 (P 1403)
Default operation: **Fault (-1)** =>25 connected to 27
(Fault => 25 connected to 26)

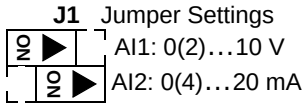
| Parameters Changed Relative to HVAC Default | | | |
|---|---|---|---|
| **Parameter** | **Value** | **Parameter** | **Value** |
| 9902 APPLIC MACRO | 4 (CLNGTWRFAN) | 3207 SUPERV 3 PARAM | 0103 (OUTPUT FREQ) |
| 1401 RELAY OUTPUT 1 | 7 (STARTED) | 4101 GAIN | 1.0 |
| 1601 RUN ENABLE | 2 (DI2) | 4102 INTEGRATION TIME | 60.0 s |
| 1609 START ENABLE 2 | 5 (DI5) | | |

### Condenser

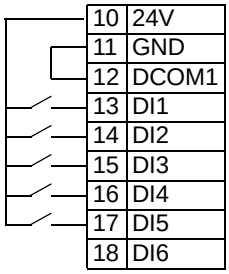
This macro configures for condenser and liquid cooler applications where fan speed is controlled according to signals received from a transducer. When using direct speed reference in AUTO mode or process PID, see "General Considerations" on page 35.



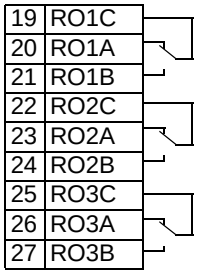

Signal cable shield (screen)
**External reference** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
Reference voltage 10 VDC
**PID feedback:** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
**Output frequency:** 0(4)…20 mA
**Output current:** 0(4)…20 mA
Analog output circuit common




Jumper Settings
AI1: 0(2)…10 V
AI2: 0(4)…20 mA




Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
**Start/Stop:** Activate to start drive
**Run permissive:** Deactivate to stop drive (P 1601)
**Constant (Preset) speed 1** (P 1202[1])
**Safety interlock 1:** Deactivate to stop drive (P 1608)
**Safety interlock 2:** Deactivate to stop drive (P 1609)
Not configured




Relay output 1 (P 1401)
Default operation: **Ready** =>19 connected to 21

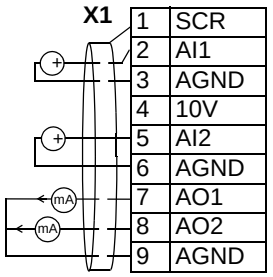
Relay output 2 (P 1402)
Default operation: **Running** =>22 connected to 24

Relay output 3 (P 1403)
Default operation: **Fault (-1)** =>25 connected to 27
(Fault => 25 connected to 26)

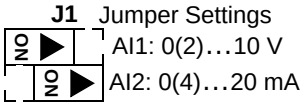
| Parameters Changed Relative to HVAC Default | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Value** | **Parameter** | | **Value** |
| 9902 | APPLIC MACRO | 5 (CONDENSER) | 2203 | DECELER TIME 1 | 10.0 s |
| 1401 | RELAY OUTPUT 1 | 7 (STARTED) | 3207 | SUPERV 3 PARAM | 0103 (OUTPUT FREQ) |
| 1601 | RUN ENABLE | 2 (DI2) | 4005 | **ERROR VALUE INV** | 1 (YES) |
| 1609 | START ENABLE 2 | 5 (DI5) | 4101 | GAIN | 1.0 |
| 2202 | ACCELER TIME 1 | 10.0 s | 4102 | INTEGRATION TIME | 60.0 s |

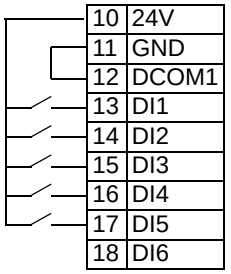
### Booster Pump

This macro configures for booster pump applications where the pump speed is controlled according to a signal received from a transducer. When using direct speed reference in AUTO mode or process PID, see "General Considerations" on page 35.

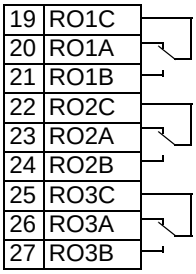



Signal cable shield (screen)
**External reference** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
Reference voltage 10 VDC
**PID feedback:** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
**Output frequency:** 0(4)…20 mA
**Output current:** 0(4)…20 mA
Analog output circuit common




Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
**Start/Stop:** Activate to start drive
**Run permissive:** Deactivate to stop drive (P 1601)
**Constant (Preset) speed 1** (P 1202[1])
**Safety interlock 1:** Deactivate to stop drive (P 1608)
**Safety interlock 2:** Deactivate to stop drive (P 1609)
Not configured




Relay output 1 (P 1401)
Default operation: **Ready** =>19 connected to 21

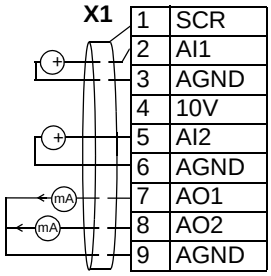
Relay output 2 (P 1402)
Default operation: **Running** =>22 connected to 24

Relay output 3 (P 1403)
Default operation: **Fault (-1)** =>25 connected to 27
(Fault => 25 connected to 26)

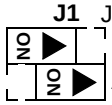
| Parameters Changed Relative to HVAC Default | | | | | |
|---|---|---|---|---|---|
| Parameter | | Value | Parameter | | Value |
| 9902 | APPLIC MACRO | 6 (BOOSTERPUMP) | 2203 | DECELER TIME 1 | 5.0 s |
| 1401 | RELAY OUTPUT 1 | 7 (STARTED) | 3207 | SUPERV 3 PARAM | 0103 (OUTPUT FREQ) |
| 1601 | RUN ENABLE | 2 (DI2) | 4001 | GAIN | 1.0 |
| 1609 | START ENABLE 2 | 5 (DI5) | 4002 | INTEGRATION TIME | 60.0 s |
| 2202 | ACCELER TIME 1 | 5.0 s | | | |

### Pump Alternation

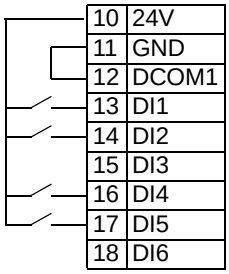
This macro configures for pump alternation applications, usually used in booster stations. To adjust/maintain pressure in the network, the speed of the one pump changes according to a signal received from a pressure transducer. When the variable speed pump reaches a maximum speed limit, auxiliary pumps start as needed. When using process PID, see "General Considerations" on page 35. To use more than one (the default) Auxiliary pump, see parameter group 81.



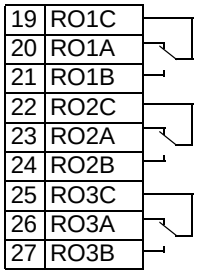

Signal cable shield (screen)
**External reference** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
Reference voltage 10 VDC
**PID feedback:** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
**Output frequency:** 0(4)…20 mA
**Output current:** 0(4)…20 mA
Analog output circuit common




Jumper Settings
AI1: 0(2)…10 V
AI2: 0(4)…20 mA




Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
**Start/Stop:** Activate to start drive
**Run permissive:** Deactivate to stop drive (P 1601)
Not configured
**PFA interlock 1:** Deactivate to stop drive (P 1608)
**PFA interlock 2:** Deactivate to stop drive (P 1609)
Not configured




Relay output 1 (P 1401)
Default operation: **PFA** (starts lag pump)

Relay output 2 (P 1402)
Default operation: **Running** =>22 connected to 24

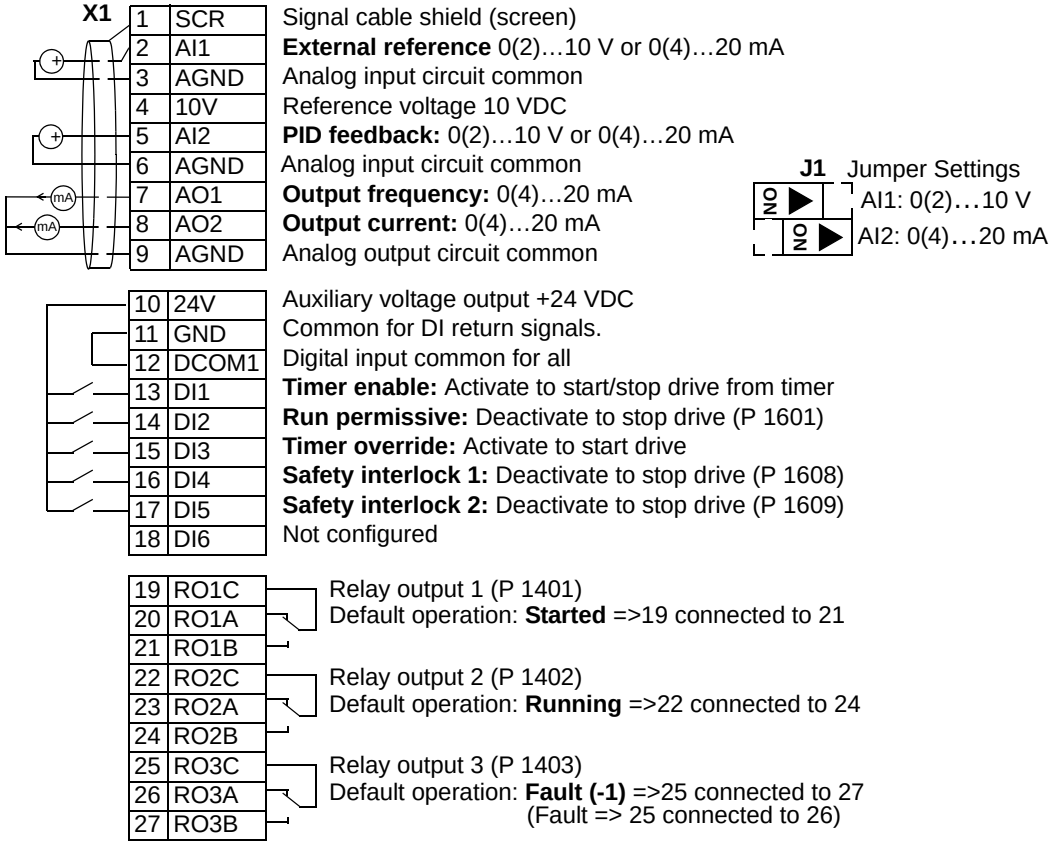
Relay output 3 (P 1403)
Default operation: **Fault (-1)** =>25 connected to 27
(Fault => 25 connected to 26)

| Parameters Changed Relative to HVAC Default | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Value** | **Parameter** | | **Value** |
| 9902 | APPLIC MACRO | 7 (PUMPALTERN) | 1609 | START ENABLE 2 | 5 (DI5) |
| 1105 | REF1 MAX | 62Hz/1860rpm | 2208 | EM DEC TIME | 62HZ |
| 1201 | CONST SPEED SEL | 0 (NOT SEL) | 2202 | ACCELER TIME 1 | 5.0 S |
| 1401 | RELAY OUTPUT 1 | 31 (PFA) | 2203 | DECELER TIME 1 | 5.0 S |
| 1503 | AO1 CONTENT MAX | 62HZ | 3207 | SUPERV 3 PARAM | 0103 (OUTPUT FREQ) |
| 1508 | AO2 CONTENT MIN | 0.0% | 4101 | GAIN | 1.0 |
| 1509 | AO2 CONTENT MAX | 100.0% | 4102 | INTEGRATION TIME | 60.0 S |
| 1601 | RUN ENABLE | 2 (DI2) | 8123 | PFA ENABLE | 1 (ACTIVE) |
| 1608 | START ENABLE 1 | 0 (NOT SEL) | | | |

### Internal Timer

This macro configures for applications where a built-in timer starts and stops the motor. When the variable speed pump reaches a maximum speed limit, auxiliary pumps start as needed. When using direct speed reference in AUTO mode or process PID, see "General Considerations" on page 35.

Momentarily activating digital input 3 (DI3) provides a boost function which operates the motor. See group 36, Timer Functions, for more information on setting up timers.

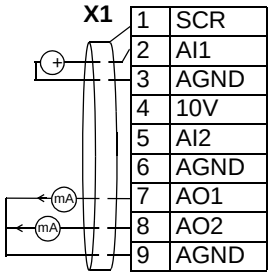



| Parameters Changed Relative to HVAC Default | | | | | |
|---|---|---|---|---|---|
| Parameter | | Value | Parameter | | Value |
| 9902 | APPLIC MACRO | 8 (INT TIMER) | 1609 | START ENABLE 2 | 5 (DI5) |
| 1001 | EXT1 COMMANDS | 11 (TIMER1) | 3207 | SUPERV 3 PARAM | 0103 (OUTPUT FREQ) |
| 1002 | EXT2 COMMANDS | 11 (TIMER1) | 3601 | TIMERS ENABLE | 1 (DI1) |
| 1201 | CONST SPEED SEL | 0 (NOT SEL) | 3622 | BOOST SEL | 3 (DI3) |
| 1401 | RELAY OUTPUT 1 | 7 (STARTED) | 3626 | TIMER 1 SRC | 23 (B+P3+P2+P1) |
| 1601 | RUN ENABLE | 2 (DI2) | | | |

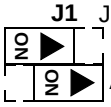
### Internal Timer with Constant Speeds / PRV

This macro configures for applications such as a timed powered roof ventilator (PRV) which alternates between two constant speeds (constant speed 1 and 2) based on a built-in timer.

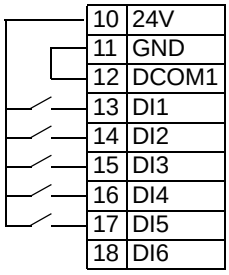
Momentarily activating digital input 3 (DI3) provides a boost function which operates the motor. See group 36, Timer Functions, for more information on setting up timers.



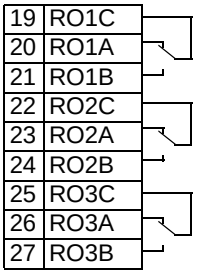

Signal cable shield (screen)
**External reference** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
Reference voltage 10 VDC
Not configured
Analog input circuit common
**Output frequency:** 0(4)…20 mA
**Output current:** 0(4)…20 mA
Analog output circuit common




Jumper Settings
AI1: 0(2)…10 V
AI2: 0(4)…20 mA




Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
**Timer enable:** Activate to start/stop drive from timer
**Run permissive:** Deactivate to stop drive (P 1601)
**Timer override:** Activate to start drive
**Safety interlock 1:** Deactivate to stop drive (P 1608)
**Safety interlock 2:** Deactivate to stop drive (P 1609)
Not configured




Relay output 1 (P 1401)
Default operation: **Started** =>19 connected to 21

Relay output 2 (P 1402)
Default operation: **Running** =>22 connected to 24

Relay output 3 (P 1403)
Default operation: **Fault (-1)** =>25 connected to 27
(Fault => 25 connected to 26)

| Parameters Changed Relative to HVAC Default | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Value** | **Parameter** | | **Value** |
| 9902 | APPLIC MACRO | 9 (INT TIMER CS) | 3416 | SIGNAL 3 MIN | -200.0% |
| 1002 | EXT2 COMMANDS | 0 (NOT SEL) | 3417 | SIGNAL 3 MAX | 200.0% |
| 1103 | REF1 SEL | 0 (KEYPAD) | 3419 | OUTPUT 3 DSP UNIT | 4 (%) |
| 1106 | REF3 SEL | 2 (AI2) | 3420 | OUTPUT 3 MIN | -200.0% |
| 1201 | CONST SPEED SEL | 15 (TIMER1) | 3421 | OUTPUT 3 MAX | 200.0% |
| 1301 | MINIMUM AI1 | 0.0% | 3622 | BOOST SEL | 3 (DI3) |
| 1401 | RELAY OUTPUT 1 | 7 (STARTED) | 4001 | GAIN | 1.0 |
| 1601 | RUN ENABLE | 2 (DI2) | 4002 | INTEGRATION TIME | 60.0 S |
| 1609 | START ENABLE 2 | 5 (DI5) | 4101 | GAIN | 1.0 |
| 3207 | SUPERV 3 PARAM | 0103 (OUTPUT FREQ) | 4102 | INTEGRATION TIME | 60.0 S |
| 3415 | SIGNAL 3 PARAM | 0105 (TORQUE) | 4110 | SETPOINT SEL | 1 (AI1) |

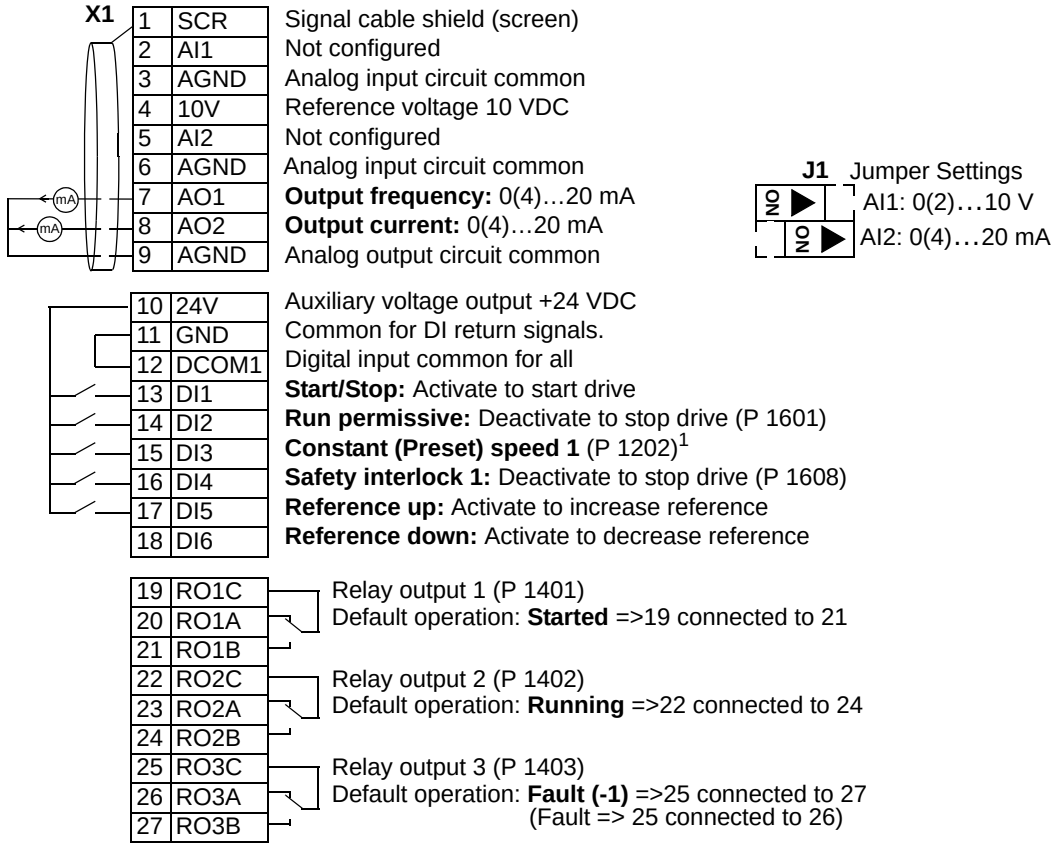
### Floating Point

This application macro is for applications where speed reference needs to be controlled through digital inputs (DI5 & DI6). By activating digital input 5, the speed reference increases, by activating digital input 6, the speed reference decreases. If both digital inputs are active or inactive, the reference does not change.

---

**Note!** When constant speed 1 is activated using digital input 3 (DI3), the reference speed is the value of parameter 1202. The value remains as the reference speed when digital input 3 is deactivated.

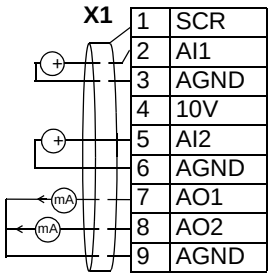
---



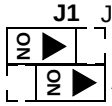

| Parameters Changed Relative to HVAC Default | | | | | |
|---|---|---|---|---|---|
| Parameter | | Value | Parameter | | Value |
| 9902 | APPLIC MACRO | 10 (FLOATINGPNT) | 3416 | SIGNAL 3 MIN | -200.0% |
| 1103 | REF1 SEL | 7 (DI5U, 6D) | 3417 | SIGNAL 3 MAX | 200.0% |
| 1401 | RELAY OUTPUT 1 | 7 (STARTED) | 3419 | OUTPUT 3 DSP UNIT | 4 (%) |
| 1601 | RUN ENABLE | 2 (DI2) | 3420 | OUTPUT 3 MIN | -200.0% |
| 3207 | SUPERV 3 PARAM | 0103 (OUTPUT FREQ) | 3421 | OUTPUT 3 MAX | 200.0% |
| 3415 | SIGNAL 3 PARAM | 0105 (TORQUE) | | | |

### Dual Setpoint with PID

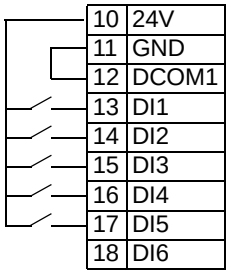
This macro configures for dual setpoint PID applications, where activating digital input 3 (DI3) changes the process PID controller's setpoint to another value. When using direct speed reference in AUTO mode or process PID, see "General Considerations" on page 35. Set process PID setpoints (internal to the drive) using parameters 4011 (SET1) and 4111 (SET2).



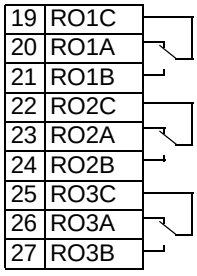
| X1 | | |
|---|---|---|
| 1 | SCR | Signal cable shield (screen) |
| 2 | AI1 | **External reference** 0(2)…10 V or 0(4)…20 mA |
| 3 | AGND | Analog input circuit common |
| 4 | 10V | Reference voltage 10 VDC |
| 5 | AI2 | **PID feedback:** 0(2)…10 V or 0(4)…20 mA |
| 6 | AGND | Analog input circuit common |
| 7 | AO1 | **Output frequency:** 0(4)…20 mA |
| 8 | AO2 | **Output current:** 0(4)…20 mA |
| 9 | AGND | Analog output circuit common |



**J1** Jumper Settings
AI1: 0(2)…10 V
AI2: 0(4)…20 mA



| | | |
|---|---|---|
| 10 | 24V | Auxiliary voltage output +24 VDC |
| 11 | GND | Common for DI return signals. |
| 12 | DCOM1 | Digital input common for all |
| 13 | DI1 | **Start/Stop:** Activate to start drive |
| 14 | DI2 | **Run permissive:** Deactivate to stop drive (P 1601) |
| 15 | DI3 | **Setpoint selection:** Activate to select Set2 |
| 16 | DI4 | **Safety interlock 1:** Deactivate to stop drive (P 1608) |
| 17 | DI5 | **Safety interlock 2:** Deactivate to stop drive (P 1609) |
| 18 | DI6 | Not configured |

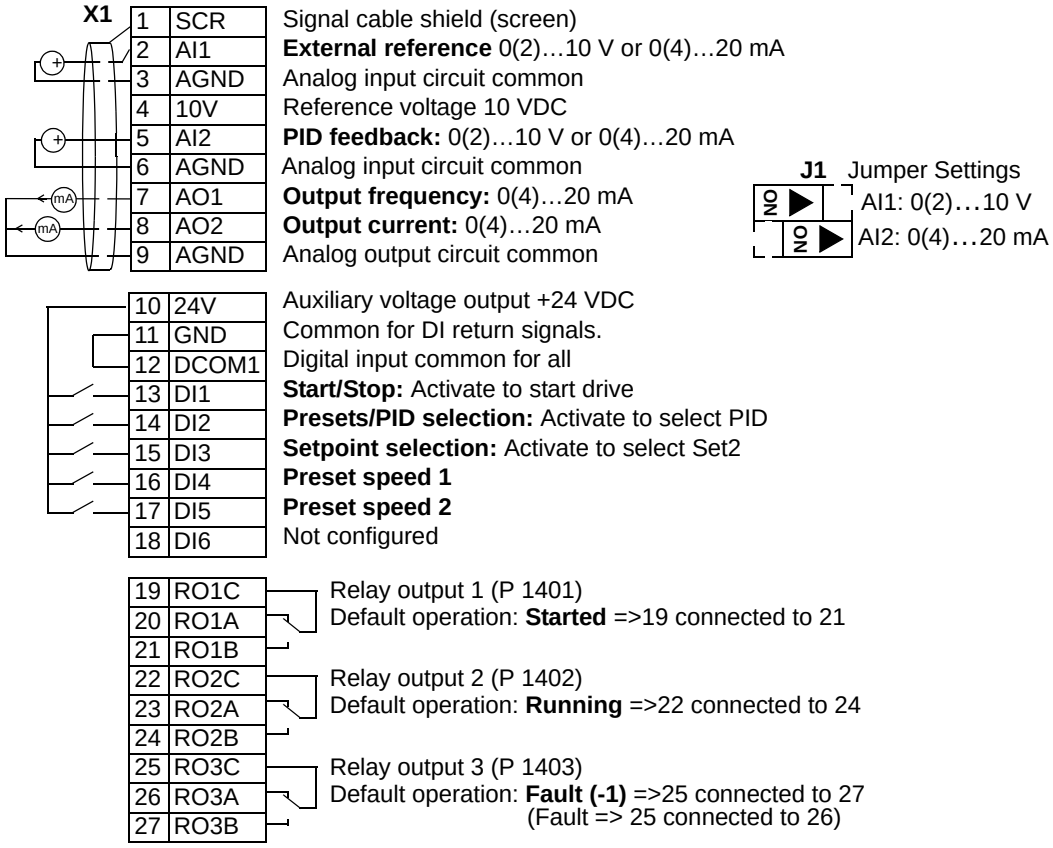


| | | |
|---|---|---|
| 19 | RO1C | Relay output 1 (P 1401) |
| 20 | RO1A | Default operation: **Started** =>19 connected to 21 |
| 21 | RO1B | |
| 22 | RO2C | Relay output 2 (P 1402) |
| 23 | RO2A | Default operation: **Running** =>22 connected to 24 |
| 24 | RO2B | |
| 25 | RO3C | Relay output 3 (P 1403) |
| 26 | RO3A | Default operation: **Fault (-1)** =>25 connected to 27 |
| 27 | RO3B | (Fault => 25 connected to 26) |

| Parameters Changed Relative to HVAC Default | | | | | |
|---|---|---|---|---|---|
| Parameter | | Value | Parameter | | Value |
| 9902 | APPLIC MACRO | 11 (DUAL SETPNT) | 4010 | SETPOINT SEL | 19 (INTERNAL) |
| 1201 | CONST SPEED SEL | 0 (NOT SEL) | 4011 | INTERNAL SETPNT | 50.0% |
| 1401 | RELAY OUTPUT 1 | 7 (STARTED) | 4027 | PID 1 PARAM SET | 3 (DI3) |
| 1601 | RUN ENABLE | 2 (DI2) | 4110 | SETPOINT SEL | 19 (INTERNAL) |
| 1609 | START ENABLE 2 | 5 (DI5) | 4111 | INTERNAL SETPNT | 100.0% |
| 3207 | SUPERV 3 PARAM | 0103 (OUTPUT FREQ) | | | |

### Dual Setpoint with PID and Constant Speeds

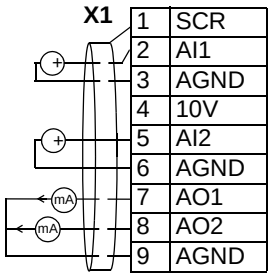
This macro configures for applications with 2 constant speeds, active PID and PID alternating between two setpoints using digital inputs. Set PID setpoints (internal to the drive) using parameters 4011 (SET1) and 4111 (SET2). The digital input DI3 selects the setpoints.



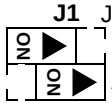

| Parameters Changed Relative to HVAC Default | | | | | |
|---|---|---|---|---|---|
| Parameter | | Value | Parameter | | Value |
| 9902 | APPLIC MACRO | 12 (DUAL SPNTCS) | 3207 | SUPERV 3 PARAM | 0103 (OUTPUT FREQ) |
| 1102 | EXT1/EXT2 SEL | 2 (DI2) | 4001 | GAIN | 0.7 |
| 1201 | CONST SPEED SEL | 11 (DI5, 6) | 4002 | INTEGRATION TIME | 10.0 S |
| 1401 | RELAY OUTPUT 1 | 7 (STARTED) | 4010 | SETPOINT SEL | 19 (INTERNAL) |
| 1608 | START ENABLE 1 | 0 (NOT SEL) | 4011 | INTERNAL SETPNT | 50.0% |
| 2108 | START INHIBIT | 1 (ON) | 4027 | PID 1 PARAM SET | 3 (DI3) |
| 2202 | ACCELER TIME 1 | 10.0 S | 4101 | GAIN | 0.7 |
| 2203 | DECELER TIME 1 | 10.0 S | 4102 | INTEGRATION TIME | 10.0 S |
| 3105 | AR OVERVOLTAGE | 0 (DISABLE) | 4110 | SETPOINT SEL | 19 (INTERNAL) |
| 3107 | AR AI<MIN | 0 (DISABLE) | 4111 | INTERNAL SETPNT | 100.0% |

### E-bypass

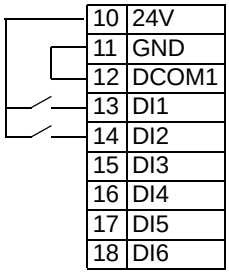
This macro configures for an Electronic Bypass device which can bypass the drive and connect the motor direct on-line. When using direct speed reference in AUTO mode or process PID, see "General Considerations" on page 35.



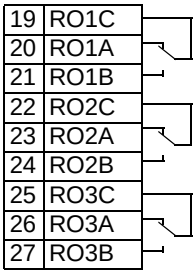

Signal cable shield (screen)
**External reference** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
Reference voltage 10 VDC
**PID feedback:** 0(2)…10 V or 0(4)…20 mA
Analog input circuit common
**Output frequency:** 0(4)…20 mA
**Output current:** 0(4)…20 mA
Analog output circuit common




Jumper Settings
AI1: 0(2)…10 V
AI2: 0(4)…20 mA




Auxiliary voltage output +24 VDC
Common for DI return signals.
Digital input common for all
**Start/Stop:** Activate to start drive
**Run enable:** Deactivate to stop drive (P 1601)
Not configured
Not configured
Not configured
Not configured




Relay output 1 (P 1401)
Default operation: **Started** =>19 connected to 21

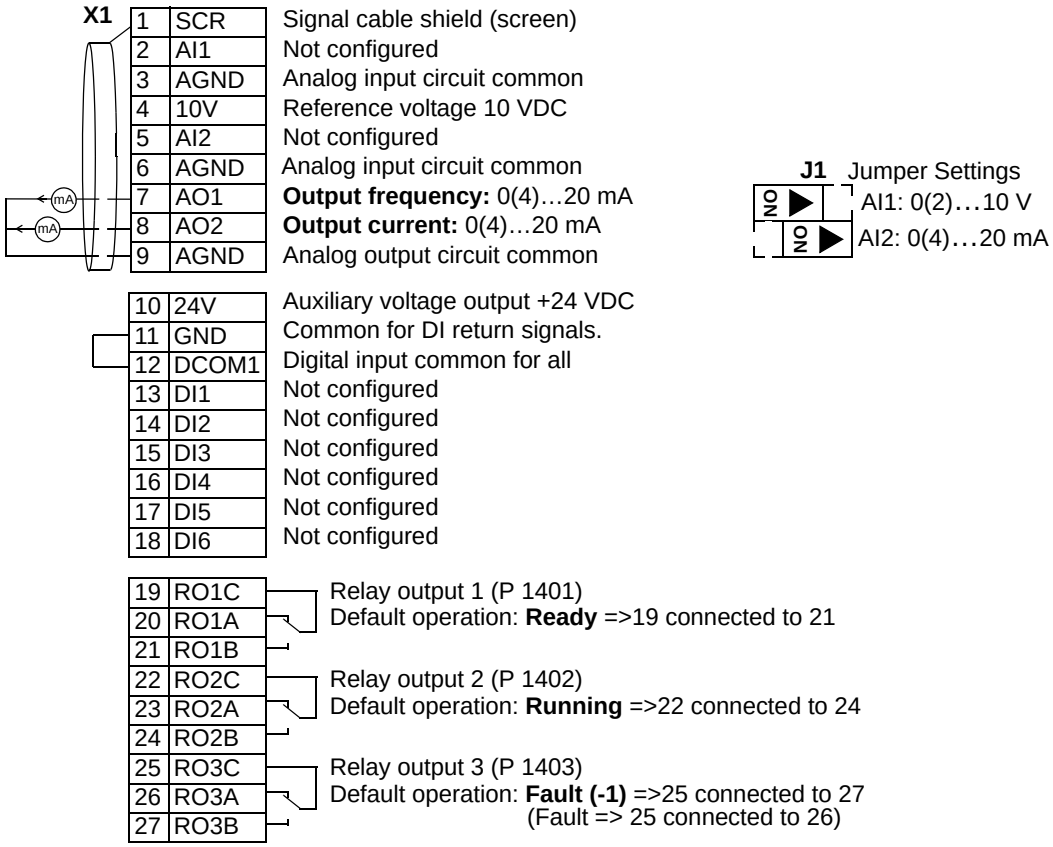
Relay output 2 (P 1402)
Default operation: **Running** =>22 connected to 24

Relay output 3 (P 1403)
Default operation: **Fault (-1)** =>25 connected to 27
(Fault => 25 connected to 26)

| Parameters Changed Relative to HVAC Default | | | | | |
|---|---|---|---|---|---|
| **Parameter** | | **Value** | **Parameter** | | **Value** |
| 9902 | APPLIC MACRO | 13 (E-BYPASS) | 1608 | START ENABLE 1 | 0 (NOT SEL) |
| 1201 | CONST SPEED SEL | 0 (NOT SEL) | 2108 | START INHIBIT | 1 (ON) |
| 1401 | RELAY OUTPUT 1 | 7 (STARTED) | 3207 | SUPERV 3 PARAM | 0103 (OUTPUT FREQ) |
| 1601 | RUN ENABLE | 2 (DI2) | | | |

### Hand Control

This macro configures for drive control using only the control panel with no automated control. Typically, this is a temporary configuration used prior to control wiring.




| Parameters Changed Relative to HVAC Default | | | | | |
|---|---|---|---|---|---|
| Parameter | | Value | Parameter | | Value |
| 9902 | APPLIC MACRO | 14 (HAND CONTROL) | 3415 | SIGNAL 3 PARAM | 100 (NOT SEL) |
| 1001 | EXT1 COMMANDS | 0 (NOT SEL) | 3416 | SIGNAL 3 MIN | (-) |
| 1002 | EXT2 COMMANDS | 0 (NOT SEL) | 3417 | SIGNAL 3 MAX | (-) |
| 1106 | REF3 SEL | 2 (AI2) | 3418 | OUTPUT 3 DSP FORM | (-) |
| 1201 | CONST SPEED SEL | 0 (NOT SEL) | 3419 | OUTPUT 3 DSP UNIT | (-) |
| 1301 | MINIMUM AI1 | 0.0% | 3420 | OUTPUT 3 MIN | (-) |
| 1304 | MINIMUM AI2 | 0.0% | 3421 | OUTPUT 3 MAX | (-) |
| 1401 | RELAY OUTPUT 1 | 7 (STARTED) | 4001 | GAIN | 1.0 |
| 1504 | MINIMUM AO1 | 0.0mA | 4002 | INTEGRATION TIME | 60.0 s |
| 1510 | MINIMUM AO2 | 0.0mA | 4010 | SETPOINT SEL | 1 (AI1) |
| 1601 | RUN ENABLE | 2 (DI2) | 4101 | GAIN | 1.0 |
| 1608 | START ENABLE 1 | 0 (NOT SEL) | 4102 | INTEGRATION TIME | 60.0 s |
| 2108 | START INHIBIT | 1 (ON) | 4110 | SETPOINT SEL | 1 (AI1) |
| 3207 | SUPERV 3 PARAM | 0103 (OUTPUT FREQ) | 4210 | SETPOINT SEL | 1 (AI1) |

# Parameter Descriptions

Parameter data is specific to ACH550 firmware version 1.51.

### Group 99: Start-up Data

This group defines special Start-up data required to:

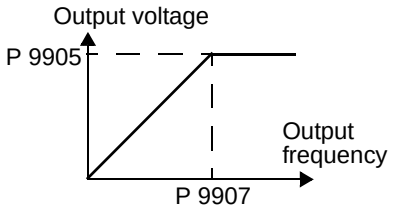
- Set up the drive.
- Enter motor information

---

**Note!** Parameters checked under the heading "S" can be modified only when the drive is stopped.

---

| Group 99: Start-up Data | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 9901 | **LANGUAGE**<br>Selects the display language.<br>0 = ENGLISH 1 = ENGLISH (AM) 2 = DEUTSCH 3 = ITALIANO<br>4 = ESPAÑOL 5 = PORTUGUES 6 = NEDERLANDS 7 = FRANCAIS<br>8 = DANSK 9 = SUOMI 10 = SVENSKA | **0…10** | **1** | **0** | |
| 9902 | **APPLIC MACRO**<br>Selects an application macro. Application macros automatically edit parameters to configure the ACH550 for a particular application. See "Application Macros" for application macro descriptions.<br>1 = HVAC DEFAULT<br>2 = SUPPLY FAN<br>3 = RETURN FAN<br>4 = COOLING TOWER FAN<br>5 = CONDENSER<br>6 = BOOSTER PUMP<br>7 = PUMP ALTERNATION<br>8 = INTERNAL TIMER<br>9 = INTERNAL TIMER WITH CONSTANT SPEEDS<br>10 = FLOATING POINT<br>11 = DUAL SETPOINT PID<br>12 = DUAL SETPOINT PID WITH CONSTANT SPEEDS<br>13 = E -BYPASS<br>14 = HAND CONTROL | **1…14** | **1** | **1** | ✓ |
| 9904 | **MOTOR CTRL MOD**<br>Selects the motor control mode.<br>1 = VECTOR: SPEED – sensorless vector control mode.<br>• Reference 1 is speed reference in rpm.<br>• Reference 2 is speed reference in % (100% is absolute maximum speed, equal to the value of parameter 2002 MAXIMUM SPEED, or 2001 MINIMUM SPEED if the absolute value of the minimum speed is greater than the maximum speed).<br>3 = SCALAR: FREQ – scalar control mode.<br>• Reference 1 is frequency reference in Hz.<br>• Reference 2 is frequency reference in % (100% is absolute maximum frequency, equal to the value of parameter 2008 MAXIMUM FREQUENCY, or 2007 MINIMUM FREQUENCY if the absolute value of the minimum speed is greater than the maximum speed). | **1, 3** | **1** | **3** | ✓ |

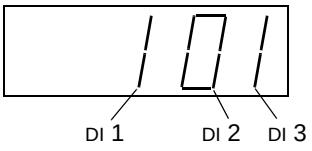
| Group 99: Start-up Data | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 9905 | **MOTOR NOM VOLT**<br>Defines the nominal motor voltage.<br>• Must equal the value on the motor rating plate.<br>• Sets the maximum drive output voltage supplied to the motor.<br>• The ACH550 cannot supply the motor with a voltage greater than the mains voltage. | **230…690 V (US)** | **1 V** | **230 V (US)**<br>  | ✓ |
| 9906 | **MOTOR NOM CURR**<br>Defines the nominal motor current.<br>• Must equal the value on the motor rating plate.<br>• Range allowed: (0.2…2.0) · $I_N$ (where $I_N$ is drive current). | **0.15*$I_{2N}$…1.5*$I_{2N}$** | **0.1 A** | **1.5*$I_{2N}$** | ✓ |
| 9907 | **MOTOR NOM FREQ**<br>Defines the nominal motor frequency.<br>• Range: 10…500 Hz (typically 50 or 60 Hz)<br>• Sets the frequency at which output voltage equals the MOTOR NOM VOLT.<br>• Field weakening point = Norm freq * Supply Volt / Mot Nom Volt | **10.0…500 Hz** | **0.1 Hz** | **60 Hz (US)** | ✓ |
| 9908 | **MOTOR NOM SPEED**<br>Defines the nominal motor speed.<br>• Must equal the value on the motor rating plate. | **50…18000 rpm** | **1 rpm** | **1580 rpm (US)** | ✓ |
| 9909 | **MOTOR NOM POWER**<br>Defines the nominal motor power.<br>• Must equal the value on the motor rating plate. | **0.15…1.5*$P_N$** | **0.1 Hp** | **0.2 HP (US)** | ✓ |
| 9910 | **MOTOR ID RUN**<br>This parameter controls a self-calibration process called the Motor Id Run. During this process, the drive operates the motor in order to identify it's characteristics, and then optimizes control by creating a motor model. This motor model is especially effective when:<br>• Operation point is near zero speed.<br>• Operation requires a torque range above the motor nominal torque, over a wide speed range, and without any measured speed feedback (i.e. without a pulse encoder).<br>If no Motor Id Run is performed, the drive uses a less detailed motor model created when the drive is first run. This "First Start" model is updated automatically* after any motor parameter is changed. To update the model, the drive magnetizes the motor for 10 to 15 seconds at zero speed.<br>*Creating the "First Start model does require that either 9904 = 1 (VECTOR: SPEED), or 9904 = 3 (SCALAR: FREQ) and 2101 = 3 (SCALAR FLYSTART) or 5 (FLYSTART + TORQ BOOST).<br>**Note:** Motor models work with internal parameters and user-defined motor parameters. In creating a model the drive does not change any user-defined parameters.<br>0 = OFF – Disables the Motor Id Run creation process. (Does not disable the operation of a motor model.)<br>1 = ON – Enables a Motor Id Run at the next start command. After run completion, this value automatically changes to 0.<br>To perform a Motor Id Run:<br>1. De-couple load from motor (or otherwise reduce load to near zero).<br>2. Verify that motor operation is safe:<br>• The run automatically operates the motor in the forward direction – confirm that forward rotation is safe.<br>• The run automatically operates the motor at 50…80% of nominal speed – confirm that operation at these speeds is safe.<br>3. Check following parameters (if changed from factory settings):<br>• 2001 MINIMUM SPEED ≤ 0<br>• 2002 MAXIMUM SPEED > 80% of motor rated speed.<br>• 2003 MAX CURRENT ≥ 130% of $I_{2N}$ value.<br>• The maximum torque (parameters 2014, 2017 and/or 2018) > 50%.<br>4. At the Control Panel, select:<br>• Select Parameters<br>• Select Group 99<br>• Select Parameter 9910 | **0, 1** | **1** | **0** | ✓ |

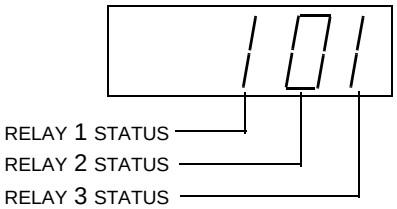
### Group 01: Operating Data

This group contains drive operating data, including actual signals. The drive sets the values for actual signals, based on measurements or calculations. You cannot set these values.

| Group 01: Operating Data | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 0102 | **SPEED**<br>The calculated speed of the motor (rpm). | **0…30000 rpm** | **1 rpm** | **-** | |
| 0103 | **OUTPUT FREQ**<br>The frequency (Hz) applied to the motor. (Also shown by default in OUTPUT display.) | **0.0…500.0 Hz** | **0.1 Hz** | **-** | |
| 0104 | **CURRENT**<br>The motor current, as measured by the ACH550. (Also shown by default in OUTPUT display.) | **0.0…1.5*$I_{2N}$** | **0.1 A** | **-** | |
| 0105 | **TORQUE**<br>Output torque. Calculated value of torque on motor shaft in % of motor nominal torque. | **-200…200%** | **0.1%** | **-** | |
| 0106 | **POWER**<br>The measured motor power in kW. | **-1.5…1.5*$P_N$** | **0.1 kW** | **-** | |
| 0107 | **DC BUS VOLTAGE**<br>The DC bus voltage in VDC, as measured by the ACH550. | **0…2.5*$V_{dN}$** | **1 V** | **-** | |
| 0109 | **OUTPUT VOLTAGE**<br>The voltage applied to the motor. | **0…2.0*$V_{dN}$** | **1 V** | **-** | |
| 0110 | **DRIVE TEMP**<br>The temperature of the drive heatsink in Centigrade. | **0…150 °C** | **0.1 °C** | **-** | |
| 0111 | **EXTERNAL REF 1**<br>External reference, REF1, in rpm or Hz – units determined by parameter 9904. | **0…30000 rpm /<br>0…500 Hz** | **1 rpm /<br>0.1 Hz** | **-** | |
| 0112 | **EXTERNAL REF 2**<br>External reference, REF2, in %. | **0…100%<br>(torque: 0…600%)** | **0.1%** | **-** | |
| 0113 | **CTRL LOCATION**<br>Active control location. Alternatives are:<br>0 = HAND<br>1 = EXT1<br>2 = EXT2 | **0…2** | **1** | **-** | |
| 0114 | **RUN TIME (R)**<br>The drive's accumulated running time in hours (h).<br>• Can be **reset** by pressing UP and DOWN buttons simultaneously when in parameter set mode. | **0…9999 h** | **1 h** | **0 h** | |
| 0115 | **KWH COUNTER (R)**<br>The drive's accumulated power consumption in kilowatt hours.<br>• Can be **reset** by pressing UP and DOWN buttons simultaneously when in parameter set mode. | **0…9999 kWh** | **1 kWh** | **-** | |
| 0116 | **APPL BLK OUTPUT**<br>Application block output signal. Value is from either:<br>• PFA control, if PFA Control is active, or<br>• Parameter 0112 EXTERNAL REF 2. | **0…100%<br>(torque: 0…600%)** | **0.1%** | **-** | |

| Group 01: Operating Data | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 0118 | **DI1-3 STATUS**<br>Status of the three digital inputs.<br>• Status is displayed as a binary number.<br>• 1 indicates that the input is activated.<br>• 0 indicates that the input is deactivated. | **000…111 (0…7 decimal)** | **1** | **-** | |
| 0119 | **DI4-6 STATUS**<br>Status of the three digital inputs.<br>• See parameter 0118 DI1-3 STATUS. | **000…111 (0…7 decimal)** | **1** | **-** | |
| 0120 | **AI1**<br>Relative value of analog input 1 in %. | **0…100%** | **0.1%** | **-** | |
| 0121 | **AI2**<br>The relative value of analog input 2 in %. | **0…100%** | **0.1%** | **-** | |
| 0122 | **RO1-3 STATUS**<br>Status of the three relay outputs.<br>• 1 indicates that the relay is energized.<br>• 0 indicates that the relay is de-energized. | **0…111 (0…7 decimal)** | **1** | **-** | |
| 0123 | **RO4-6 STATUS**<br>Status of the three relay outputs. See parameter 0122. | **0…111 (0…7decimal)** | **1** | **-** | |
| 0124 | **AO1**<br>The analog output 1 value in milliamperes. | **0…20 mA** | **0.1 mA** | **-** | |
| 0125 | **AO2**<br>The analog output 2 value in milliamperes. | **0…20 mA** | **0.1 mA** | **-** | |
| 0126 | **PID 1 OUTPPUT**<br>The PID Controller 1 output value in %. | **-1000…1000%** | **0.1%** | **-** | |
| 0127 | **PID 2 OUTPUT**<br>The PID Controller 2 output value in %. | **-100…100%** | **0.1%** | **-** | |
| 0128 | **PID 1 SETPNT**<br>The PID 1 controller setpoint signal.<br>• Units and scale defined by PID parameters 4006/4106 & 4007/4107. | **-** | **-** | **-** | |
| 0129 | **PID 2 SETPNT**<br>The PID 2 controller setpoint signal.<br>• Units and scale defined by PID parameters 4206 & 4207. | **-** | **-** | **-** | |
| 0130 | **PID 1 FBK**<br>The PID 1 controller feedback signal.<br>• Units and scale defined by PID parameters 4006/4106 & 4007/4107. | **-** | **-** | **-** | |



| Group 01: Operating Data | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 0131 | **PID 2 FBK**<br>The PID 2 controller feedback signal.<br>• Units and scale defined by PID parameters 4206 & 4207. | **-** | **-** | **-** | |
| 0132 | **PID 1 DEVIATION**<br>The difference between the PID 1 controller reference value and actual value.<br>• Units and scale defined by PID parameters 4006/4106 & 4007/4107. | **-** | **-** | **-** | |
| 0133 | **PID 2 DEVIATION**<br>The difference between the PID 2 controller reference value and actual value.<br>• Units and scale defined by PID parameters 4206 & 4207. | **-** | **-** | **-** | |
| 0134 | **COMM RO WORD**<br>Free data location that can be written from serial link.<br>• Used for relay output control.<br>• See parameter 1401. | **0…65535** | **1** | **0** | |
| 0135 | **COMM VALUE 1**<br>Free data location that can be written from serial link. | **-32768…+32767** | **1** | **0** | |
| 0136 | **COMM VALUE 2**<br>Free data location that can be written from serial link. | **-32768…+32767** | **1** | **0** | |
| 0137 | **PROCESS VAR 1**<br>Process variable 1<br>• Defined by parameters in Group 34: Panel Display / Process Variables. | **-** | **1** | | |
| 0138 | **PROCESS VAR 2**<br>Process variable 2<br>• Defined by parameters in Group 34: Panel Display / Process Variables. | **-** | **1** | | |
| 0139 | **PROCESS VAR 3**<br>Process variable 3<br>• Defined by parameters in Group 34: Panel Display / Process Variables. | **-** | **1** | | |
| 0140 | **RUN TIME**<br>The drive's accumulated running time in thousands of hours (kh). | **0…499.99 kh** | **0.01 kh** | **0 kh** | |
| 0141 | **MWH COUNTER**<br>The drive's accumulated power consumption in megawatt hours. Can not be reset. | **0…9999 MWh** | **1 MWh** | **-** | |
| 0142 | **REVOLUTION CNTR**<br>The motor's accumulated revolutions in millions of revolutions. | **0…9999** | **1** | **0** | |
| 0143 | **DRIVE ON TIME (HI)**<br>The drive's accumulated power on time in days. | **0…65535 days** | **1 day** | **0** | |
| 0144 | **DRIVE ON TIME (LO)**<br>The drive's accumulated power on time in 2 second ticks (30 ticks = 60 seconds). | **0…43200hh:mm:ss** | **2 s** | **0** | |
| 0145 | **MOTOR TEMP**<br>Motor temperature in degrees centigrade / PTC resistance in Ohms.<br>• Applies only if motor temperature sensor is set up. See parameter 3501. | **-10...200 °C/<br>0...5000 Ohm /<br>0…1** | **1** | **0** | |

### Group 03: Actual Signals

This group monitors fieldbus communications.

| Group 03: Actual Signals | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 0301 | **FB CMD WORD 1** | **-** | **-** | **-** | |
| | Read-only copy of the Fieldbus Command Word 1.<br>• The fieldbus command is the principal means for controlling the drive from a fieldbus controller. The command consists of two Command Words. Bit-coded instructions in the Command Words switch the drive between states.<br>• To control the drive, using the Command Words, an external location (EXT1 or EXT2) must be active and set to COMM. (See parameters 1001 and 1002.)<br>• The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays as 0001. All zeros and a 1 in BIt 15 displays as 8000 | | | | |

| Bit # | 0301, FB CMD WORD 1 | 0302, FB CMD WORD 2 |
|---|---|---|
| 0 | STOP | FBLOCAL_CTL |
| 1 | START | FBLOCAL_REF |
| 2 | REVERSE | START_DISABLE1 |
| 3 | LOCAL | START_DISABLE2 |
| 4 | RESET | Reserved |
| 5 | EXT2 | Reserved |
| 6 | RUN_DISABLE | Reserved |
| 7 | STPMODE_R | Reserved |
| 8 | STPMODE_EM | Reserved |
| 9 | STPMODE_C | Reserved |
| 10 | RAMP_2 | Reserved |
| 11 | RAMP_OUT_0 | REF_CONST |
| 12 | RAMP_HOLD | REF_AVE |
| 13 | RAMP_IN_0 | LINK_ON |
| 14 | RREQ_LOCALLOC | REQ_STARTINH |
| 15 | TORQLIM2 | OFF_INTERLOCK |

| | | | | | |
|---|---|---|---|---|---|
| 0302 | **FB CMD WORD 2** | **-** | **-** | **-** | |
| | Read-only copy of the Fieldbus Command Word 2.<br>• See parameter 0301. | | | | |

| Group 03: Actual Signals | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 0303 | **FB STS WORD 1** | **-** | **1** | **- hex** | |

Read-only copy of the Status Word 1.
- The drive sends status information to the fieldbus controller. The status consists of two Status Words.

| Bit # | 0303, STS CMD WORD 1 | 0304, FB STS WORD 2 |
|---|---|---|
| 0 | READY | ALARM |
| 1 | ENABLED | REQ_MAINT |
| 2 | STARTED | DIRLOCK |
| 3 | RUNNING | LOCALLOCK |
| 4 | ZERO_SPEED | CTL_MODE |
| 5 | ACCELERATE | Reserved |
| 6 | DECELERATE | Reserved |
| 7 | AT_SETPOINT | Reserved |
| 8 | LIMIT | Reserved |
| 9 | SUPERVISION | Reserved |
| 10 | REV_REF | REQ_CTL |
| 11 | REV_ACT | REQ_REF1 |
| 12 | PANEL_LOCAL | REQ_REF2 |
| 13 | FIELDBUS_LOCAL | REQ_REF2EXT |
| 14 | EXT2_ACT | ACK_STARTINH |
| 15 | FAULT | ACK_OFF_ILCK |

| | | | | | |
|---|---|---|---|---|---|
| 0304 | **FB STS WORD 2** | **-** | **1** | **- hex** | |

Read-only copy of the Status Word 2.
- See parameter 0303.

| Group 03: Actual Signals | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 0305 | **FAULT WORD 1** | **-** | **1** | **0000 hex** | |

Read-only copy of the Fault Word 1.
- When a fault is active, the corresponding bit for the active fault is set in the Fault Words.
- Each fault has a dedicated bit allocated within Fault Words.
- See *"Fault Listing"* in section *"Diagnostics"* for a description of the faults.
- The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays a 0001. All zeros and a 1 in Bit 15 displays as 8000.

| Bit # | 0305, FAULT WORD 1 | 0306, FAULT WORD 2 | 0307, FAULT WORD 3 |
|---|---|---|---|
| 0 | OVERCURRENT | UNDERLOAD | EFB 1 |
| 1 | DC OVERVOLT | THERM FAIL | EFB 2 |
| 2 | DEV OVERTEMP | OPEX LINK | EFB 3 |
| 3 | SHORT CIRC | OPEX PWR | Reserved |
| 4 | OVERLOAD | CURR MEAS | Reserved |
| 5 | DC UNDERVOLT | SUPPLY PHASE | Reserved |
| 6 | AI1 LOSS | Reserved | Reserved |
| 7 | AI2 LOSS | OVERSPEED | Reserved |
| 8 | MOT OVERTEMP | DC HIGH RUSH | Reserved |
| 9 | PANEL LOSS | DRIVE ID | Reserved |
| 10 | ID RUN FAIL | CONFIG FILE | Reserved |
| 11 | MOTOR STALL | SERIAL 1 ERR | System Error |
| 12 | Reserved | EFB CON FILE | System Error |
| 13 | EXT FLT 1 | FORCE TRIP | System Error |
| 14 | EXT FLT 2 | MOTOR PHASE | Hardware Error |
| 15 | EARTH FAULT | OUTPUT WIRING | Param. Setting Fault |

| | | | | | |
|---|---|---|---|---|---|
| 0306 | **FAULT WORD 2** | **-** | **1** | **0000 hex** | |

Read-only copy of the Fault Word 2.
- See parameter 0305.

| | | | | | |
|---|---|---|---|---|---|
| 0307 | **FAULT WORD 3** | **-** | **1** | **0000 hex** | |

Read-only copy of the Fault Word 3.
- See parameter 0305.

| Group 03: Actual Signals | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 0308 | **ALARM WORD 1** | **-** | **1** | **0000 hex** | |

Read-only copy of the ALARM WORD 1.
- When a fault is active, the corresponding bit for the active fault is set in the Fault Words.
- Each fault has a dedicated bit allocated within Fault Words.
- Bits remain set until the whole alarm word is reset. (Reset by writing zero to the word).
- The control panel displays the word in hex. For example, all zeros and a 1 in Bit 0 displays a 0001. All zeros and a 1 in Bit 15 displays as 8000.

| Bit # | 0308, ALARM WORD 1 | 0309, ALARM WORD 2 |
|---|---|---|
| 0 | Reserved | Reserved / OFFBUTTON 0* |
| 1 | | PID SLEEP |
| 2 | | ID RUN |
| 3 | DIR LOCK | Reserved |
| 4 | I/O COMM | |
| 5 | AI1 LOSS | |
| 6 | AI2 LOSS | |
| 7 | PANEL LOSS | |
| 8 | Reserved | |
| 9 | MOT OVERTEMP | |
| 10 | UNDERLOAD | |
| 11 | MOTOR STALL | |
| 12 | AUTORESET | |
| 13 | AUTOCHANGE | |
| 14 | PFA INTERLOCK | |
| 15 | reserved BP LOSS | |

* Applies only to HVAC drives.

| | | | | | |
|---|---|---|---|---|---|
| 0309 | **ALARM WORD 2** | **-** | **1** | **0000 hex** | |

Read-only copy of the ALARM WORD 3.
- See parameter 0308.

### Group 04: Fault History

This group stores a recent history of the faults reported by the drive.

| Group 04: Fault History | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 0401 | **LAST FAULT** | **Fault code text** | **1** | **0** | |
| | 0 = Clear the fault history (on panel = NO RECORD).<br>n = Fault code of the last recorded fault. | | | | |
| 0402 | **FAULT TIME 1** | **Date dd.mm.yy / power-on days** | **1** | **0** | |
| | The day on which the last fault occurred. Either as:<br>• A date – if real time clock is operating.<br>• The number of days after power on – if real time clock is not used, or was not set. | | | | |
| 0403 | **FAULT TIME 2** | **Time hh:mm:ss** | **2 s** | **0** | |
| | The time at which the last fault occurred. Either as:<br>• Real time, in format hh:mm:ss – if real time clock is operating.<br>• The time since power on (less the whole days reported in 0402), in format hh:mm:ss – if real time clock is not used, or was not set. | | | | |
| 0404 | **SPEED AT FLT** | **-** | **1 rpm** | **0** | |
| | The motor speed (rpm) at the time the last fault occurred. | | | | |
| 0405 | **FREQ AT FLT** | **-** | **0.1 Hz** | **0.0** | |
| | The frequency (Hz) at the time the last fault occurred. | | | | |
| 0406 | **VOLTAGE AT FLT** | **-** | **0.1 V** | **0.0** | |
| | The DC bus voltage (V) at the time the last fault occurred. | | | | |
| 0407 | **CURRENT AT FLT** | **-** | **0.1 A** | **0.0** | |
| | The motor current (A) at the time the last fault occurred. | | | | |
| 0408 | **TORQUE AT FLT** | **-** | **0.1%** | **0.0** | |
| | The motor torque (%) at the time the last fault occurred. | | | | |
| 0409 | **STATUS AT FLT** | **-** | **1** | **0000 hex** | |
| | The drive status (hex code word) at the time the last fault occurred. | | | | |
| 0410 | **DI1-3 AT FLT** | **000…111 (0…7 decimal)** | **1** | **000 bin** | |
| | The status of digital inputs 1…3 at the time the last fault occurred. | | | | |
| 0411 | **DI4-6 AT FLT** | **000…111 (0…7 decimal)** | **1** | **000 bin** | |
| | The status of digital inputs 4…6 at the time the last fault occurred. | | | | |
| 0412 | **PREVIOUS FAULT 1** | **Fault code text** | **1** | **0** | |
| | Fault code of the second last fault. Read-only. | | | | |
| 0413 | **PREVIOUS FAULT 2** | **Fault code text** | **1** | **0** | |
| | Fault code of the third last fault. Read-only. | | | | |

### Group 10: Start/Stop/Dir

This group:

- Defines external sources (EXT1, and EXT2) for commands that enable start, stop and direction changes.
- Locks direction or enables direction control. To select between the two external locations use the next group, parameter 1102.

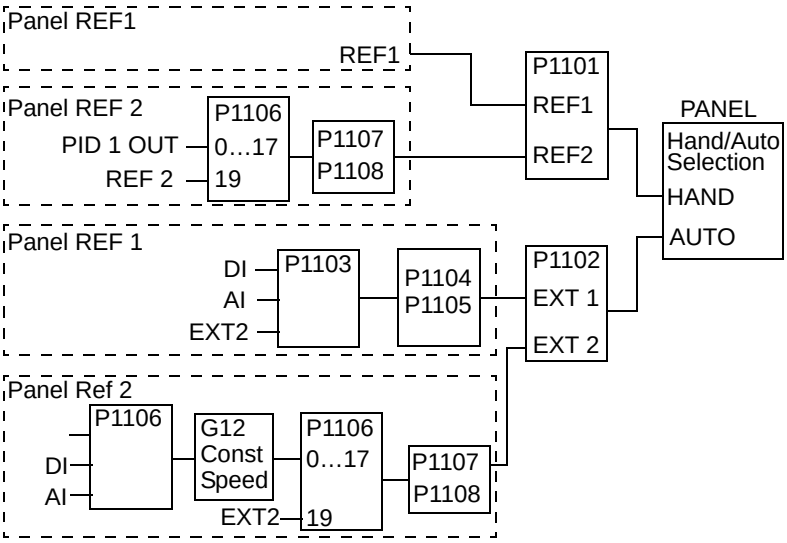
| Group 10: AcStart/Stop?Dir | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1001 | **EXT1 COMMANDS** | **0…14** | **1** | **1** | ✓ |
| | Defines external control location 1 (EXT1) – the configuration of start, stop and direction commands.<br>0 = NOT SEL – No external start, stop and direction command source.<br>1 = DI1 – Two-wire Start/Stop.<br>• Start/Stop is through digital input DI1 (DI1 activated = Start; DI1 de-activated = Stop).<br>• Parameter 1003 defines the direction. Selecting 1003 = 3 (request) is the same as 1003 = 1 (fwd).<br>2 = DI1, 2 – Two-wire Start/Stop, Direction.<br>• Start/Stop is through digital input DI1 (DI1 activated = Start; DI1 de-activated = Stop).<br>• Direction control (requires parameter 1003 = 3 (request)) is through digital input DI2 (DI2 activated = Reverse; de-activated = Forward).<br>3 = DI1P, 2P – Three-wire Start/Stop.<br>• Start/Stop commands are through momentary push-buttons (the P stands for "pulse").<br>• Start is through a normally open push-button connected to digital input DI1. In order to start the drive, the digital input DI2 must be activated prior the pulse in DI1.<br>• Connect multiple Start push-buttons in parallel.<br>• Stop is through a normally closed push-button connected to digital input DI2.<br>• Connect multiple Stop push-buttons in series.<br>• Parameter 1003 defines the direction. Selecting 1003 = 3 (REQUEST) is the same as 1003 = 1 (FWD).<br>4 = DI1P, 2P, 3 – Three-wire Start/Stop, Direction.<br>• Start/Stop commands are through momentary push-buttons, as described for DI1P, 2P.<br>• Direction control (requires parameter 1003 = 3 (REQUEST)) is through digital input DI3 (DI3 activated = Reverse; de-activated = Forward). | | | | |
| | 5 = DI1P, 2P, 3P – Start Forward, Start Reverse, and Stop.<br>• Start and Direction commands are given simultaneously with two separate momentary push-buttons (the P stands for "pulse").<br>• Start Forward command is through a normally open push-button connected to digital input DI1. In order to start the drive, the digital input DI3 must be activated during the pulse in DI1.<br>• Start Reverse command is through a normally open push-button connected to digital input DI2. In order to start the drive, the digital input DI3 must be activated prior the pulse in DI2.<br>• Connect multiple Start push-buttons in parallel.<br>• Stop is through a normally closed push-button connected to digital input DI3.<br>• Connect multiple Stop push-buttons in series.<br>• Requires parameter 1003 = 3 (REQUEST).<br>6 = DI6 – Two-wire Start/Stop.<br>• Start/Stop is through digital input DI6 (DI6 activated = Start; DI6 de-activated = Stop).<br>• Parameter 1003 defines the direction. Selecting 1003 = 3 (REQUEST) is the same as 1003 = 1 (FWD).<br>7 = DI6, 5 – Two-wire Start/Stop/Direction.<br>• Start/Stop is through digital input DI6 (DI6 activated = Start; DI6 de-activated = Stop).<br>• Direction control (requires parameter 1003 = 3 (REQUEST)) is through digital input DI5. (DI5 activated = Reverse; de-activated = Forward).<br>8 = KEYPAD – Control Panel.<br>• Start/Stop and Direction commands are through the control panel when EXT1 is active.<br>• Direction control requires parameter 1003 = 3 (REQUEST).<br>9 = DI1F, 2R – Start/Stop/Direction commands through DI1 and DI2 combinations.<br>• Start forward = DI1 activated and DI2 de-activated.<br>• Start reverse = DI1 de-activated and DI2 activated.<br>• Stop = both DI1 and DI2 activated, or both de-activated.<br>• Requires parameter 1003 = 3 (REQUEST). | | | | |

| Group 10: AcStart/Stop?Dir | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| | 10 = COMM – Assigns the fieldbus Command Word as the source for the start/stop and direction commands.<br>• Bits 0,1, 2 of Command Word 1 (parameter 0301) activates the start/stop and direction commands.<br>• See Fieldbus user's manual for detailed instructions.<br>11 = TIMER 1. – Assigns Start/Stop control to Timer 1 (Timer activated = START; Timer de-activated = STOP). See Group 36, Timer Functions.<br>12…14 = TIMER 2… 4 – Assigns Start/Stop control to Timer 2…4. See Timer Function 1 above. | | | | |
| 1002 | **EXT2 COMMANDS** | **0…14** | **1** | **1** | ✓ |
| | Defines external control location 2 (EXT2) – the configuration of start, stop and direction commands.<br>• See parameter 1001 EXT1 COMMANDS above. | | | | |
| 1003 | **DIRECTION** | **1…3** | **1** | **1** | ✓ |
| | Defines the control of motor rotation direction.<br>1 = FORWARD – Rotation is fixed in the forward direction.<br>2 = REVERSE – Rotation is fixed in the reverse direction.<br>3 = REQUEST – Rotation direction can be changed on command. | | | | |

### Group 11: Reference Select

This group defines:

- How the drive selects between command sources.
- Characteristics and sources for REF1 and REF2.

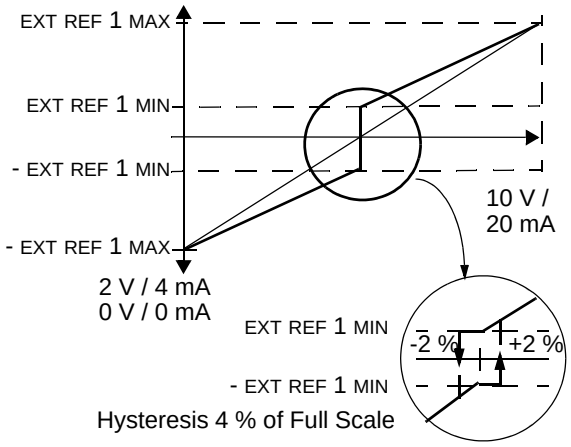



| Group 11: Reference Select | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1101 | **KEYPAD REF SEL** | **1…2** | **1** | **1** | |
| | Selects the reference controlled in local control mode.<br>1 = REF1 (Hz/rpm) – Reference type depends on parameter 9904 MOTOR CTRL MODE.<br>• Speed reference (rpm) if 9904 = 1 (VECTOR: SPEED).<br>• Frequency reference (Hz) if 9904 = 3 (SCALAR; FREQ).<br>2 = REF2 (%) | | | | |
| 1102 | **EXT1/EXT2 SEL** | **-6…12** | **1** | **0** | ✓ |
| | Defines the source for selecting between the two external control locations EXT1 or EXT2. Thus, defines the source for Start/Stop/Direction commands and reference signals.<br>0 = EXT1 – Selects external control location 1 (EXT1).<br>• See parameter 1001 EXT1 COMMANDS for EXT1's Start/Stop/Dir definitions.<br>• See parameter 1103 REF1 SELECT for EXT1's reference definitions.<br>1 = DI1 – Assigns control to EXT1 or EXT2 based on the state of DI1 (DI1 activated = EXT2; DI1 de-activated = EXT1).<br>2…6 = DI2…DI6 – Assigns control to EXT1 or EXT2 based on the state of the selected digital input. See DI1 above.<br>7 = EXT2 – Selects external control location 2 (EXT2).<br>• See parameter 1002 EXT2 COMMANDS for EXT2's Start/Stop/Dir definitions.<br>• See parameter 1106 REF2 SELECT for EXT2's reference definitions.<br>8 = COMM – Assigns control of the drive via external control location EXT1 or EXT2 based on the fieldbus control word.<br>• Bit 5 of the Command Word 1 (parameter 0301) defines the active external control location (EXT1 or EXT2).<br>• See Fieldbus user's manual for detailed instructions.<br>9 = TIMER 1 – Assigns control to EXT1 or EXT2 based on the state of the Timer (Timer activated = EXT2; Timer de-activated = EXT1). See Group 36, Timer Functions.<br>10…12 = TIMER 2… 4 – Assigns control to EXT1 or EXT2 based on the state of the Timer. See Timer 1 above.<br>-1 = DI1(INV) – Assigns control to EXT1 or EXT2 based on the state of DI1 (DI1 activated = EXT1; DI1 de-activated = EXT2).<br>-2…-6 = DI2(INV)…DI6(INV) – Assigns control to EXT1 or EXT2 based on the state of the selected digital input. See DI1(INV) above. | | | | |

| Group 11: Reference Select | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1103 | **REF1 SELECT** | **0…17** | **1** | **1** | ✓ |

Selects the signal source for external reference REF1.
0 = KEYPAD – Defines the control panel as the reference source.
1 = AI1 – Defines analog input 1 (AI1) as the reference source.
2 = AI2 – Defines analog input 2 (AI2) as the reference source.
3 = AI1/JOYST – Defines analog input 1 (AI1), configured for joystick operation, as the reference source.
- The minimum input signal runs the drive at the maximum reference in the reverse direction. Define the minimum using parameter 1104.
- The maximum input signal runs the drive at maximum reference in the forward direction. Define the maximum using parameter 1105.
- Requires parameter 1003=3 (request).

**Warning! Because the low end of the reference range commands full reverse operation, do not use 0 V as the lower end of the reference range. Doing so means that if the control signal is lost (which is a 0 V input) the result is full reverse operation. Instead, use the following set-up so that loss of the analog input triggers a fault, stopping the drive:**
- Set parameter 1301 MINIMUM AI1 (1304 MINIMUM AI2) at 20% (2 V or 4 mA).
- Set parameter 3021 AI1 FAULT LIMIT to a value 5% or higher.
- Set parameter 3001 AI<MIN FUNCTION to 1 (FAULT).




4 = AI2/JOYST – Defines analog input 2 (AI2), configured for joystick operation, as the reference source.
- See above (AI2/JOYST) description.

5 = DI3U,4D(R) – Defines digital inputs as the speed reference source (motor potentiometer control).
- Digital input DI3 increases the speed (the U stands for "up").
- Digital input DI4 decreases the speed (the D stands for "down").
- A Stop command resets the reference to zero (the R stands for "reset").
- Parameter 2205 ACCELER TIME 2 controls the reference signal's rate of change.

6 = DI3U,4D – Same as above (DI3U,4D(R)), except:
- A Stop command does not reset the reference to zero. The reference is stored.
- When the drive restarts, the motor ramps up (at the selected acceleration rate) to the stored reference.

7 = DI5U,6D – Same as above (DI3U,4D), except that DI5 and DI6 are the digital inputs used.
8 = COMM – Defines the fieldbus as the reference source.
9 = COMM+AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below.
10 = COMM*AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below.
11 = DI3U, 4D(RNC) – Same as DI3U,4D(R) above, except that:
- Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference.

12 = DI3U,4D(NC) – Same as DI3U,4D above, except that:
- Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference.

13 = DI5U,6D(NC) – Same as DI3U,4D above, except that:
- Changing the control source (EXT1 to EXT2, EXT2 to EXT1, LOC to REM) does not copy the reference.

14 = AI1+AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.
15 = AI1*AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.
16 = AI1-AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.
17 = AI1/AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.

**Group 11: Reference Select**

| Code | Description | Range | Resolution | Default | S |
|---|---|---|---|---|---|

**Analog Input Reference Correction**

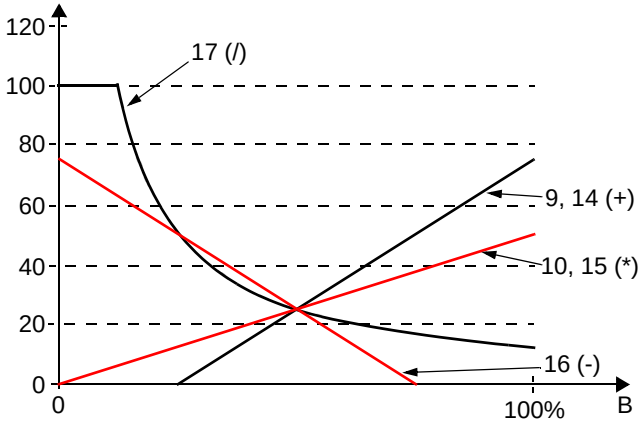
Parameter values 9, 10, and 14…17 use the formula in the following table.

| Value Setting | AI reference is calculated as following: |
|---|---|
| C + B | C value + (B value - 50% of reference value) |
| C * B | C value * (B value / 50% of reference value) |
| C - B | (C value + 50% of reference value) - B value |
| C / B | (C value * 50% of reference value) / B value |

Where:
- C = Main Reference value ( = COMM for values 9, 10 and = AI1 for values 14…17).
- B = Correcting reference ( = AI1 for values 9, 10 and = AI2 for values 14…17).

**Example:**

The figure shows the reference source curves for value settings 9, 10, and 14…17, where:
- C = 25%.
- P 4012 SETPOINT MIN = 0.
- P 4013 SETPOINT MAX = 0.
- B varies along the horizontal axis.

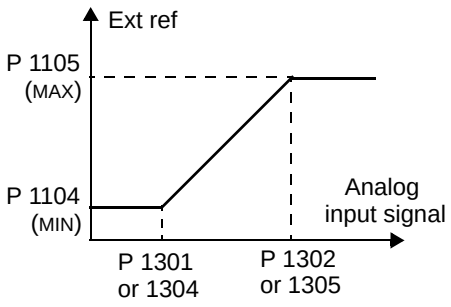


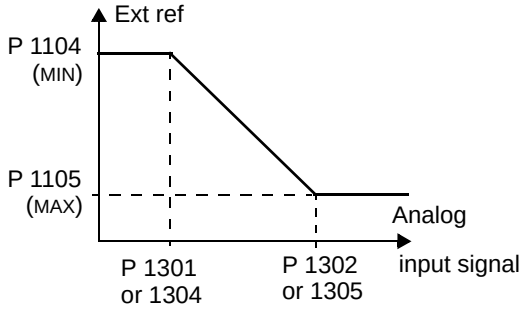

| | | | | | |
|---|---|---|---|---|---|
| 1104 | **REF1 MIN** | **0.0…500.0 Hz**<br>**0…30000 rpm** | **0.1 Hz**<br>**1 rpm** | **0.0 Hz**<br>**0 rpm** | |

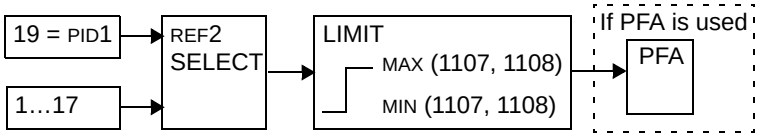
Sets the minimum for external reference 1.
- The minimum analog input signal (as a percent of the full signal in volts or amps) corresponds to REF1 MIN in Hz/rpm.
- Parameter 1301 MINIMUM AI1 or 1304 MINIMUM AI2 sets the minimum analog input signal.
- These parameters (reference and analog min. and max. settings) provide scale and offset adjustment for the reference.

| | | | | | |
|---|---|---|---|---|---|
| 1105 | **REF1 MAX** | **0.0…500.0 Hz**<br>**0…30000 rpm** | **0.1 Hz**<br>**1 rpm** | **60.0 Hz (US)**<br>**1800 rpm (US)** | |

Sets the maximum for external reference 1.
- The maximum analog input signal (as a percent of full the signal in volts or amps) corresponds to REF1 MAX in Hz/rpm.
- Parameter 1302 MAXIMUM AI1 or 1305 MAXIMUM AI2 sets the maximum analog input signal.



| Group 11: Reference Select | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1106 | **REF2 SELECT** | **0…19** | **1** | **19** | ✓ |
| | Selects the signal source for external reference REF2.<br>0…17 – Same as for parameter 1103 REF1 SELECT.<br>19 = PID1OUT – The reference is taken from the PID1 output. See Groups 40 and 41.<br>  | | | | |
| 1107 | **REF2 MIN** | **0.0…100.0%**<br>**(torque: 0…600%)** | **0.1%** | **0.0%** | |
| | Sets the minimum for external reference 2.<br>• The minimum analog input signal (in volts or amps) corresponds to REF2 MIN in %.<br>• Parameter 1301 MINIMUM AI1 or 1304 MINIMUM AI2 sets the minimum analog input signal.<br>• This parameter sets the minimum frequency reference.<br>• The value is a percentage of the:<br>– maximum frequency or speed<br>– maximum process reference<br>– nominal torque | | | | |
| 1108 | **REF2 MAX** | **0.0…100.0%**<br>**(torque: 0…600%)** | **0.1%** | **100.0%** | |
| | Sets the maximum for external reference 2.<br>• The maximum analog input signal (in volts or amps) corresponds to REF2 MAX in %.<br>• Parameter 1302 MAXIMUM AI1 or 1305 MAXIMUM AI2 sets the maximum analog input signal.<br>• This parameter sets the maximum frequency reference.<br>• The value is a percentage of the:<br>– maximum frequency or speed<br>– maximum process reference<br>– nominal torque | | | | |

### Group 12: Constant Speeds

This group defines a set of constant speeds. In general:

- You can program up to 7 constant speeds, ranging from 0…500 Hz or 0…30000 rpm.
- Values must be positive (No negative speed values for constant speeds).
- Constant speed selections are ignored if:
  - the torque control is active, or
  - the process PID reference is followed, or
  - the drive is in local control mode, or
  - PFA (Pump and Fan Alternation) is active

**Note!** Parameter 1208 CONST SPEED 7 acts also as a so-called fault speed which may be activated if the control signal is lost. Refer to parameter 3001 AI<MIN FUNCTION and parameter 3002 PANEL COMM ERROR.

| Group 12: Constant Speeds | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1201 | **CONST SPEED SEL** | **-14 …19** | **1** | 3 | ✓ |

Defines the digital inputs used to select Constant Speeds. See general comments in the introduction.
0 = NOT SEL – Disables the constant speed function.
1 = DI1 – Selects Constant Speed 1 with digital input DI1.
• Digital input activated = Constant Speed 1 activated.
2…6 = DI2…DI6 – Selects Constant Speed 1 with digital input DI2…DI6. See above.
7 = DI1,2 – Selects one of three Constant Speeds (1…3) using DI1 and DI2.
• Uses two digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):

| DI1 | DI2 | Function |
|---|---|---|
| 0 | 0 | No constant speed |
| 1 | 0 | Constant speed 1 (1202) |
| 0 | 1 | Constant speed 2 (1203) |
| 1 | 1 | Constant speed 3 (1204) |

• Can be set up as a so-called fault speed, which is activated if the control signal is lost. Refer to parameter 3001 AI<MIN function and parameter 3002 PANEL COMM ERR.

8 = DI2,3 – Selects one of three Constant Speeds (1…3) using DI2 and DI3.
• See above (DI1,2) for code.
9 = DI3,4 – Selects one of three Constant Speeds (1…3) using DI3 and DI4.
• See above (DI1,2) for code.
10 = DI4,5 – Selects one of three Constant Speeds (1…3) using DI4 and DI5.
• See above (DI1,2) for code.
11 = DI5,6 – Selects one of three Constant Speeds (1…3) using DI5 and DI6.
• See above (DI1,2) for code.

**Group 12: Constant Speeds**

| Code | Description | Range | Resolution | Default | S |
|---|---|---|---|---|---|

12 = DI1,2,3 – Selects one of seven Constant Speeds (1…7) using DI1, DI2 and DI3.
• Uses three digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):

| DI1 | DI2 | DI3 | Function |
|---|---|---|---|
| 0 | 0 | 0 | No constant speed |
| 1 | 0 | 0 | Constant speed 1 (1202) |
| 0 | 1 | 0 | Constant speed 2 (1203) |
| 1 | 1 | 0 | Constant speed 3 (1204) |
| 0 | 0 | 1 | Constant speed 4 (1205) |
| 1 | 0 | 1 | Constant speed 5 (1206) |
| 0 | 1 | 1 | Constant speed 6 (1207) |
| 1 | 1 | 1 | Constant speed 7 (1208) |

13 = DI3,4,5 – Selects one of seven Constant Speeds (1…7) using DI3, DI4 and DI5.
• See above (DI1,2,3) for code.
14 = DI4,5,6 – Selects one of seven Constant Speeds (1…7) using DI5, DI6 and DI7.
• See above (DI1,2,3) for code.
15…18 = TIMER 1…4 – Specifies the timer used to select a Constant Speed as the reference. The reference selection depends on the state of the selected timer, and the value of 1209 TIMED MODE SEL. See table. To enable and set timers, see Group 36, Timer Functions.

| 1201 = | 15 | 16 | 17 | 18 | Reference | |
|---|---|---|---|---|---|---|
| Timer: | 1 | 2 | 3 | 4 | 1209 = 1 | 1209 = 2 |
| Timer State | 0 | | | | External reference | Constant Speed 1 |
| | 1 | | | | Constant Speed 1 | Constant Speed 2 |

19 = TIMER 1&2 – Specifies that Timers 1 and 2 are used together to select a Constant Speed as the reference. The reference selection depends on the states of these timers, and the value of 1209 TIMED MODE SEL. See table. To enable and set timers, see Group 36, Timer Functions.

| 1201 = 19 | | Reference | |
|---|---|---|---|
| Timer 1 | Timer 2 | | |
| (used together) | | 1209 = 1 | 1209 = 2 |
| 0 | 0 | External reference | Constant Speed 1 |
| 1 | 0 | Constant Speed 1 | Constant Speed 2 |
| 0 | 1 | Constant Speed 2 | Constant Speed 3 |
| 1 | 1 | Constant Speed 3 | Constant Speed 4 |

-1 = DI1(INV) – Selects Constant Speed 1 with digital input DI1.
• Inverse operation: Digital input de-activated = Constant Speed 1 activated.
-2…- 6 = DI2(INV)…DI6(INV) – Selects Constant Speed 1 with digital input. See above.

-7 = DI1,2(INV) – Selects one of three Constant Speeds (1…3) using DI1 and DI2.
• Inverse operation uses two digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):

| DI1 | DI2 | Function |
|---|---|---|
| 1 | 1 | No constant speed |
| 0 | 1 | Constant speed 1 (1202) |
| 1 | 0 | Constant speed 2 (1203) |
| 0 | 0 | Constant speed 3 (1204) |

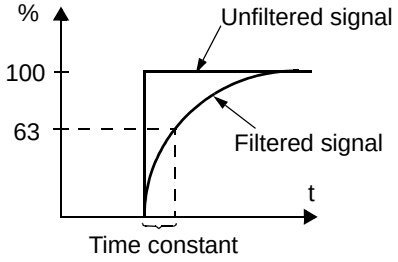
-8 = DI2,3(INV) – Selects one of three Constant Speeds (1…3) using DI2 and DI3.
• See above (DI1,2(INV)) for code.

-9 = DI3,4(INV) – Selects one of three Constant Speeds (1…3) using DI3 and DI4.
• See above (DI1,2(INV)) for code.
-10 = DI4,5(INV) – Selects one of three Constant Speeds (1…3) using DI4 and DI5.
• See above (DI1,2(INV)) for code.
-11 = DI5,6(INV) – Selects one of three Constant Speeds (1…3) using DI5 and DI6.
• See above (DI1,2(INV)) for code.

| Group 12: Constant Speeds | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| | -12 = DI1,2,3(INV) – Selects one of seven Constant Speeds (1…7) using DI1, DI2 and DI3.<br>• Inverse operation uses three digital inputs, as defined below (0 = DI de-activated, 1 = DI activated):<br><br>**DI1 / DI2 / DI3 / Function**<br>1 / 1 / 1 / No constant speed<br>0 / 1 / 1 / Constant speed 1 (1202)<br>1 / 0 / 1 / Constant speed 2 (1203)<br>0 / 0 / 1 / Constant speed 3 (1204)<br>1 / 1 / 0 / Constant speed 4 (1205)<br>0 / 1 / 0 / Constant speed 5 (1206)<br>1 / 0 / 0 / Constant speed 6 (1207)<br>0 / 0 / 0 / Constant speed 7 (1208)<br><br>-13 = DI3,4,5(INV) – Selects one of seven Constant Speeds (1…3) using DI3, DI4 and DI5.<br>• See above (DI1,2,3(INV)) for code.<br>-14 = DI4,5,6(INV) – Selects one of seven Constant Speeds (1…3) using DI4, DI5 and DI6.<br>• See above (DI1,2,3(INV)) for code. | | | | |
| 1202 | **CONST SPEED 1** | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **360 (US)/ 6.0 (US)** | |
| | Sets value for Constant Speed 1.<br>• The range and units depend on parameter 9904 MOTOR CTRL MODE.<br>• Range: 0…30000 rpm when 9904 = 1 (VECTOR: SPEED).<br>• Range: 0…500 Hz when 9904 = 3 (SCALAR: FREQ). | | | | |
| 1203 | **CONST SPEED 2** | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **360 (US)/ 12.0 (US)** | |
| | Sets a value for a Constant Speed. (See CONST SPEED 1 above.) | | | | |
| 1204 | **CONST SPEED 3** | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **720 (US)/ 18.0 (US)** | |
| 1205 | **CONST SPEED 3** | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **1080 (US)/ 18.0 (US)** | |
| | Sets a value for a Constant Speed. (See CONST SPEED 1 above.) | | | | |
| 1206 | **CONST SPEED 3** | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **1440 (US)/ 24.0 (US)** | |
| | Sets a value for a Constant Speed. (See CONST SPEED 1 above.) | | | | |
| 1207 | **CONST SPEED 3** | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **1800 (US)/ 30.0 (US)** | |
| | Sets a value for a Constant Speed. (See CONST SPEED 1 above.) | | | | |
| 1208 | **CONST SPEED 3** | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **2880 (US)/ 48.0 (US)** | |
| | Sets a value for a Constant Speed. (See CONST SPEED 1 above.) | | | | |
| 1209 | **TIMED MODE SEL** | **1…2** | **1** | **2** | ✓ |
| | Uses the timer(s) specified by parameter 1201, values 15…19, to override the reference defined in Group 11, Reference Select. This override applies only if the timer function is enabled (parameter 3601).<br>1 = EXT/CS1/2/3 – The state of the timer(s) specified by param 1201, values 15…19, determines the reference used. See tables in 1201 at appropriate value.<br>2 = CS1/2/3/4 – The state of the timer(s) specified by param 1201, values 15…19, determines the reference used. See tables in 1201 at appropriate value. | | | | |

### Group 13: Analog Inputs

This group defines the limits and the filtering for analog inputs.

| Group 13: Analog Inputs | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1301 | **MINIMUM AI1** | **0.0…100.0%** | **0.1%** | **20.0%** | |
| | Defines the minimum value of the analog input.<br>• Define value as a percent of the full analog signal range. See example below.<br>• The minimum analog input signal corresponds to 1104 REF1 MIN or 1107 REF2 MIN.<br>• MINIMUM AI cannot be greater than MAXIMUM AI.<br>• These parameters (reference and analog min. and max. settings) provide scale and offset adjustment for the reference.<br>• See figure at parameter 1104.<br>**Example.** To set the minimum analog input value to 4 mA:<br>• Configure the analog input for 0…20 mA current signal.<br>• Calculate the minimum (4 mA) as a percent of full range (20 mA) = 4 mA / 20 mA * 100% = 20% | | | | |
| 1302 | **MAXIMUM AI1** | **0.0…100.0%** | **0.1%** | **100.0%** | |
| | Defines the maximum value of the analog input.<br>• Define value as a percent of the full analog signal range.<br>• The maximum analog input signal corresponds to 1105 REF1 MAX or 1108 REF2 MAX.<br>• See figure at parameter 1104. | | | | |
| 1303 | **FILTER AI1** | **0.0…10.0 s** | **0.1 s** | **0.1 s** | |
| | Defines the filter time constant for analog input 1 (AI1).<br>• The filtered signal reaches 63% of a step change within the time specified.<br>  | | | | |
| 1304 | **MINIMUM AI2** | **0.0…100.0%** | **0.1%** | **20.0%** | |
| | Defines the minimum value of the analog input.<br>• See MINIMUM AI1 above. | | | | |
| 1305 | **MAXIMUM AI2** | **0.0…100.0%** | **0.1%** | **100.0%** | |
| | Defines the maximum value of the analog input.<br>• See MAXIMUM AI1 above. | | | | |
| 1306 | **FILTER AI2** | **0.0…10.0 s** | **0.1 s** | **0.1 s** | |
| | Defines the filter time constant for analog input 2 (AI2).<br>• See FILTER AI1 above. | | | | |

### Group 14: Relay Outputs

This group defines the condition that activates each of the relay outputs.

| Group 14: Relay Outputs | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1401 | **RELAY OUTPUT 1** | **0…45** | **1** | **1** | |
| | Defines the event or condition that activates relay 1 – what relay output 1 means.<br>0 = NOT SEL – Relay is not used and is de-energized.<br>1 = READY – Energize relay when drive is ready to function. Requires:<br>• Run enable signal present.<br>• No faults exist.<br>• Supply voltage is within range.<br>• Emergency Stop command is not on.<br>2 = RUN – Energize relay when the drive is running.<br>3 = FAULT (-1) – Energize relay when power is applied. De-energizes when a fault occurs.<br>4 = FAULT – Energize relay when a fault is active.<br>5 = ALARM – Energize relay when an alarm is active.<br>6 = REVERSED – Energize relay when motor rotates in reverse direction.<br>7 = STARTED – Energize relay when drive receives a start command (even if Run Enable signal is not present). De-energized relay when drive receives a stop command or a fault occurs.<br>8 = SUPRV1 OVER – Energize relay when first supervised parameter (3201) exceeds the limit (3203).<br>• See "Group 32: Supervision" starting on page 101.<br>9 = suprv1 under – Energize relay when first supervised parameter (3201) drops below the limit (3202).<br>• See "Group 32: Supervision" starting on page 101.<br>10 = suprv2 over – Energize relay when second supervised parameter (3204) exceeds the limit (3206).<br>• See "Group 32: Supervision" starting on page 101.<br>11 = suprv2 under – Energize relay when second supervised parameter (3204) drops below the limit (3205).<br>• See "Group 32: Supervision" starting on page 101.<br>12 = suprv3 over – Energize relay when third supervised parameter (3207) exceeds the limit (3209).<br>• See "Group 32: Supervision" starting on page 101.<br>13 = suprv3 under – Energize relay when third supervised parameter (3207) drops below the limit (3208).<br>• See "Group 32: Supervision" starting on page 101.<br>14 = AT SET POINT – Energize relay when the output frequency is equal to the reference frequency.<br>15 = FAULT (RST) – Energize relay when the drive is in a fault condition and will reset after the programmed auto-reset delay.<br>• See parameter 3103 delay time.<br>16 = FLT/ALARM – Energize relay when fault or alarm occurs.<br>17 = EXT CTRL – Energize relay when external control is selected.<br>18 = REF 2 SEL – Energize relay when EXT2 is selected.<br>19 = CONST FREQ – Energize relay when a constant speed is selected.<br>20 = REF LOSS – Energize relay when reference or active control place is lost.<br>21 = OVERCURRENT – Energize relay when an overcurrent alarm or fault occurs.<br>22 = OVERVOLTAGE – Energize relay when an overvoltage alarm or fault occurs.<br>23 = DRIVE TEMP – Energize relay when a drive overtemperature alarm or fault occurs.<br>24 = UNDERVOLTAGE – Energize relay when an undervoltage alarm or fault occurs.<br>25 = AI1 LOSS – Energize relay when AI1 signal is lost.<br>26 = AI2 LOSS – Energize relay when AI2 signal is lost.<br>27 = MOTOR TEMP – Energize relay when a motor overtemperature alarm or fault occurs.<br>28 = STALL – Energize relay when a stall alarm or fault exists.<br>29 = UNDERLOAD – Energize relay when an underload alarm or fault occurs.<br>30 = PID SLEEP – Energize relay when the PID sleep function is active.<br>31 = PFA – Use relay to start/stop motor in PFA control (See Group 81: PFA Control).<br>• Use this option only when PFA control is used.<br>• Selection activated / deactivated when drive is not running.<br>32 = AUTOCHANGE – Energize relay when PFA autochange operation is performed.<br>• Use this option only when PFA control is used.<br>33 = FLUX READY – Energize relay when the motor is magnetized and able to supply nominal torque (motor has reached nominal magnetizing).<br>34 = USER S2 – Energize relay when User Parameter Set 2 is active. | | | | |

**Group 14: Relay Outputs**

| Code | Description | Range | Resolution | Default | S |
|---|---|---|---|---|---|

35 = COMM – Energize relay based on input from fieldbus communication.
• Fieldbus writes binary code in parameter 0134 that can energizes relay 1…relay 6 according to the following:

| Par. 0134 | Binary | RO6 | RO5 | RO4 | RO3 | RO2 | RO1 |
|---|---|---|---|---|---|---|---|
| 0 | 000000 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 000001 | 0 | 0 | 0 | 0 | 0 | 1 |
| 2 | 000010 | 0 | 0 | 0 | 0 | 1 | 0 |
| 3 | 000011 | 0 | 0 | 0 | 0 | 1 | 1 |
| 4 | 000100 | 0 | 0 | 0 | 1 | 0 | 0 |
| 5…62 | … | … | … | … | … | … | … |
| 63 | 111111 | 1 | 1 | 1 | 1 | 1 | 1 |

• 0 = De-energize relay, 1 = Energize relay.

36 = COMM(-1) – Energize relay based on input from fieldbus communication.
• Fieldbus writes binary code in parameter 0134 that can energizes relay 1…relay 6 according to the following:

| Par. 0134 | Binary | RO6 | RO5 | RO4 | RO3 | RO2 | RO1 |
|---|---|---|---|---|---|---|---|
| 0 | 000000 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 000001 | 1 | 1 | 1 | 1 | 1 | 0 |
| 2 | 000010 | 1 | 1 | 1 | 1 | 0 | 1 |
| 3 | 000011 | 1 | 1 | 1 | 1 | 0 | 0 |
| 4 | 000100 | 1 | 1 | 1 | 0 | 1 | 1 |
| 5…62 | … | … | … | … | … | … | … |
| 63 | 111111 | 0 | 0 | 0 | 0 | 0 | 0 |

• 0 = De-energize relay, 1 = Energize relay.

37 = TIMER 1 – Energize relay when timer 1 is activated. See Group 36, Timer Functions.

38…40 = TIMER 2…4 – Energize relay when Timer 2…4 is active. See Timer 1 above.

41 = M.TRIG FAN – Energize relay when cooling fan counter is triggered.
42 = M.TRIG REV – Energize relay when revolutions counter is triggered.
43 = M. TRIG RUN – Energize relay when run time counter is triggered.
44 = M.TRIG MWH – Energize relay when power consumption counter is triggered.
45 = OVERRIDE – Energize relay when override is activated.

| | | | | | |
|---|---|---|---|---|---|
| 1402 | **RELAY OUTPUT 2** | **0…45** | **1** | **2** | |

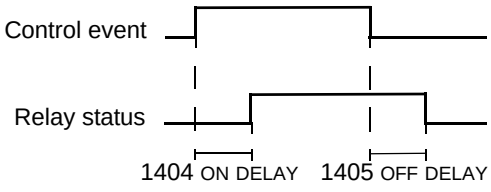
Defines the event or condition that activates relay 2 – what relay output 2 means.
• See 1401 RELAY OUTPUT 1.

| | | | | | |
|---|---|---|---|---|---|
| 1403 | **RELAY OUTPUT 3** | **0…45** | **1** | **3** | |

Defines the event or condition that activates relay 3 – what relay output 3 means.
• See 1401 RELAY OUTPUT 1.

| | | | | | |
|---|---|---|---|---|---|
| 1404 | **RO 1 ON DELAY** | **0.0…3600.0 s** | **0.1 s** | **0.0 s** | |

Defines the switch-on delay for relay 1.
• On / off delays are ignored when relay output 1401 is set to PFA.




| | | | | | |
|---|---|---|---|---|---|
| 1405 | **RO 1 OFF DELAY** | **0.0…3600.0 s** | **0.1 s** | **0.0 s** | |

Defines the switch-off delay for relay 1.
• On / off delays are ignored when relay output 1401 is set to PFA.

| | | | | | |
|---|---|---|---|---|---|
| 1406 | **RO 2 ON DELAY** | **0.0…3600.0 s** | **0.1 s** | **0.0 s** | |

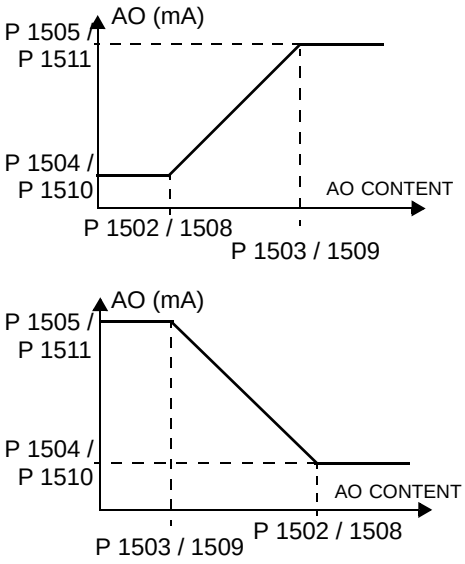
Defines the switch-on delay for relay 2.
• See RO 1 ON DELAY.

| Group 14: Relay Outputs | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1407 | **RO 2 OFF DELAY**<br>Defines the switch-off delay for relay 2.<br>• See RO 1 OFF DELAY. | **0.0…3600.0 s** | **0.1 s** | **0.0 s** | |
| 1408 | **RO 3 ON DELAY**<br>Defines the switch-on delay for relay 3.<br>• See RO 1 ON DELAY. | **0.0…3600.0 s** | **0.1 s** | **0.0 s** | |
| 1409 | **RO 3 OFF DELAY**<br>Switch-off delay for relay 3.<br>• See RO 1 OFF DELAY. | **0.0…3600.0 s** | **0.1 s** | **0.0 s** | |
| 1410… 1412 | **RELAY OUTPUT 4…6**<br>Defines the event or condition that activates relay 4…6 – what relay output 4…6 means.<br>• See 1401 RELAY OUTPUT 1. | **0…45** | **1** | **0** | |
| 1413 | **RO 4 ON DELAY**<br>Defines the switch-on delay for relay 4.<br>• See RO 1 ON DELAY. | **0.0…3600.0 s** | **0.1 s** | **0.0 s** | |
| 1414 | **RO 4 OFF DELAY**<br>Defines the switch-off delay for relay 4.<br>• See RO 1 OFF DELAY. | **0.0…3600.0 s** | **0.1 s** | **0.0 s** | |
| 1415 | **RO 5 ON DELAY**<br>Defines the switch-on delay for relay 5.<br>• See RO 1 ON DELAY. | **0.0…3600.0 s** | **0.1 s** | **0.0 s** | |
| 1416 | **RO 5 OFF DELAY**<br>Defines the switch-off delay for relay 5.<br>• See RO 1 OFF DELAY. | **0.0…3600.0 s** | **0.1 s** | **0.0 s** | |
| 1417 | **RO 6 ON DELAY**<br>Defines the switch-on delay for relay 6.<br>• See RO 1 ON DELAY. | **0.0…3600.0 s** | **0.1 s** | **0.0 s** | |
| 1418 | **RO 6 OFF DELAY**<br>Defines the switch-off delay for relay 6.<br>• See RO 1 OFF DELAY. | **0.0…3600.0 s** | **0.1 s** | **0.0 s** | |

### Group 15: Analog Outputs

This group defines the drive's analog (current signal) outputs. The drive's analog outputs can be:

- Any parameter of the Operating Data group (Group 01).
- Limited to programmable minimum and maximum values of output current.
- Scaled (and/or inverted) by defining the minimum and maximum values of the source parameter (or content). Defining an maximum value (parameter 1503 or 1509) that is less than the content minimum value (parameter 1502 or 1508) results in an inverted output.
- Filtered

| Group 15: Analog Outputs | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1501 | **AO1 CONTENT SEL**<br>Defines the content for analog output AO1.<br>99 = EXCITE PTC – Provides a current source for sensor type PTC. Output = 1.6 mA. See Group 35.<br>100 = EXCITE PT100 – Provides a current source for sensor type Pt100. Output = 9.1 mA. See Group 35.<br>101…145 – Output corresponds to a parameter in the Operating Data group (Group 01).<br>• Parameter defined by value (value 102 = parameter 0102)<br>146…199 – Not assigned.<br>  | **99…199** | **1** | **103** | |
| 1502 | **AO1 CONTENT MIN**<br>Sets the minimum content value.<br>• Content is the parameter selected by parameter 1501.<br>• Minimum value refers to the minimum content value that will be converted to an analog output.<br>• These parameters (content and current min. and max. settings) provide scale and offset adjustment for the output. See figure. | **Depends on selection** | - | 0.0 Hz | |
| 1503 | **AO1 CONTENT MAX**<br>Sets the maximum content value<br>• Content is the parameter selected by parameter 1501.<br>• Maximum value refers to the maximum content value that will be converted to an analog output. | **Depends on selection** | - | 60.0 Hz | |
| 1504 | **MINIMUM AO1**<br>Sets the minimum output current. | **0.0…20.0 mA** | **0.1 mA** | **4.0 mA** | |
| 1505 | **MAXIMUM AO1**<br>Sets the maximum output current. | **0.0…20.0 mA** | **0.1 mA** | **20.0 mA** | |

| Group 15: Analog Outputs | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1506 | **FILTER AO1** | **0…10 s** | **0.1 s** | **0.1 s** | |
| | Defines the filter time constant for AO1.<br>• The filtered signal reaches 63% of a step change within the time specified.<br>• See figure in parameter 1303. | | | | |
| 1507 | **AO2 CONTENT SEL** | **99…199** | **1** | **104** | |
| | Defines the content for analog output AO2. See AO1 CONTENT above. | | | | |
| 1508 | **AO2 CONTENT MIN** | **Depends on selection** | - | **0.0 A** | |
| | Sets the minimum content value. See AO1CONTENT MIN above. | | | | |
| 1509 | **AO2 CONTENT MAX** | **Depends on selection** | - | **4.6 A** | |
| | Sets the maximum content value. See AO1 CONTENT MAX above. | | | | |
| 1510 | **MINIMUM AO2** | **0**.0**…20.0 mA** | **0.1 mA** | **4.0 mA** | |
| | Sets the minimum output current. See MINIMUM AO1 above. | | | | |
| 1511 | **MAXIMUM AO2** | **0**.0**…20.0 mA** | **0.1 mA** | **20.0 mA** | |
| | Sets the maximum output current. See MAXIMUM AO1 above. | | | | |
| 1512 | **FILTER AO2** | **0**.0**…10**.0 **s** | **0.1 s** | **0.1 s** | |
| | Defines the filter time constant for AO2. See FILTER AO1 above. | | | | |

### Group 16: System Controls

This group defines a variety of system level locks, resets and enables.

| Group 16: System Controls | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1601 | **RUN ENABLE** | **-6…7** | **1** | **0** | ✓ |
| | Selects the source of the run enable signal.<br>0 = NOT SEL – Allows the drive to start without an external run enable signal.<br>1 = DI1 – Defines digital input DI1 as the run enable signal.<br>• This digital input must be activated for run enable.<br>• If the voltage drops and de-activates this digital input, the drive will coast to stop and not start until the run enable signal resumes.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the run enable signal.<br>• See DI1 above.<br>7 = COMM – Assigns the fieldbus Command Word as the source for the run enable signal.<br>• Bit 6 of the Command Word 1 (parameter 0301) activates the run disable signal.<br>• See fieldbus user's manual for detailed instructions.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as the run enable signal.<br>• This digital input must be de-activated for run enable.<br>• If this digital input activates, the drive will coast to stop and not start until the run enable signal resumes.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the run enable signal.<br>• See DI1(INV) above. | | | | |
| 1602 | **PARAMETER LOCK** | **0…2** | **1** | **1** | |
| | Determines if the control panel can change parameter values.<br>• This lock does not limit parameter changes made by macros.<br>• This lock does not limit parameter changes written by fieldbus inputs.<br>0 = LOCKED – You cannot use the control panel to change parameter values.<br>• The lock can be opened by entering the valid pass code to parameter 1603.<br>1 = OPEN – You can use the control panel to change parameter values.<br>2 = NOT SAVED – You can use the control panel to change parameter values, but they are not stored in permanent memory.<br>• Set parameter 1607 PARAM SAVE to 1 (SAVE) to store changed parameter values to memory. | | | | |
| 1603 | **PASS CODE** | **0…65535** | **1** | **0** | |
| | Entering the correct pass code unlocks the parameter lock.<br>• See parameter 1602 above.<br>• The code 358 opens the lock.<br>• This entry reverts back to 0 automatically. | | | | |
| 1604 | **FAULT RESET SEL** | **-6…8** | **1** | **0** | |
| | Selects the source for the fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists.<br>0 = KEYPAD – Defines the control panel as the only fault reset source.<br>• Fault reset is always possible with control panel.<br>1 = DI1 – Defines digital input DI1 as a fault reset source.<br>• Activating the digital input resets the drive.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as a fault reset source.<br>• See DI1 above.<br>7 = START/STOP – Defines the Stop command as a fault reset source.<br>• Do not use this option when fielbus communication provides the start, stop and direction commands.<br>8 = COMM – Defines the fieldbus as a fault reset source.<br>• The Command Word is supplied through fieldbus communication.<br>• The bit 4 of the Command Word 1 (parameter 0301) resets the drive.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as a fault reset source.<br>• De-activating the digital input resets the drive.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as a fault reset source.<br>• See DI1(INV) above. | | | | |

| Group 16: System Controls | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1605 | **USER PAR SET CHG** | **-6…6** | **1** | **0** | |
| | Defines control for changing the user parameter set.<br>• See parameter 9902 (APPLIC MACRO).<br>• The drive must be stopped to change User Parameter Sets.<br>• During a change, the drive will not start.<br>**Note:** Always save the User Parameter Set after changing any parameter settings, or performing a motor identification.<br>• Whenever the power is cycled, or parameter 9902 (APPLIC MACRO) is changed, the drive loads the last settings saved. Any unsaved changes to a user parameter set are lost.<br>**Note:** The value of this parameter (1605) is not included in the User Parameter Sets, and does not change if User Parameter Sets change.<br>**Note:** You can use a relay output to supervise the selection of User Parameter Set 2.<br>• See parameter 1401.<br>0 = NOT SEL – Defines the control panel (using parameter 9902) as the only control for changing User Parameter Sets.<br>1 = DI1 – Defines digital input DI1 as a control for changing User Parameter Sets.<br>• The drive loads User Parameter Set 1 on the falling edge of the digital input.<br>• The drive loads User Parameter Set 2 on the rising edge of the digital input.<br>• The User Parameter Set changes only when the drive is stopped.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as a control for changing User Parameter Sets.<br>• See DI1 above.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as a control for changing User Parameter Sets.<br>• The drive loads User Parameter Set 1 on the rising edge of the digital input.<br>• The drive loads User Parameter Set 2 on the falling edge of the digital input.<br>• The User Parameter Set changes only when the drive is stopped.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as a control for changing User Parameter Sets.<br>• See DI1(INV) above. | | | | |
| 1606 | **LOCAL LOCK** | **-6…8** | **1** | **0** | |
| | Defines control for the use of the HAND mode. The HAND mode allows drive control from the control panel.<br>• When LOCAL LOCK is active, the control panel cannot change to HAND mode.<br>0 = NOT SEL – Disables the lock. The control panel can select HAND and control the drive.<br>1 = DI1 – Defines digital input DI1 as the control for setting the local lock.<br>• Activating the digital input locks out local control.<br>• De-activating the digital input enable the HAND selection.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for setting the local lock.<br>• See DI1 above.<br>7 = ON – Sets the lock. The control panel cannot select HAND, and cannot control the drive.<br>8 = COMM – Defines bit 14 of the Command Word 1 as the control for setting the local lock.<br>• The Command Word is supplied through fieldbus communication.<br>• The Command Word is 0301.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as the control for setting the local lock.<br>• De-activating the digital input locks out local control.<br>• Activating the digital input enable the HAND selection.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for setting the local lock.<br>• See DI1(INV) above. | | | | |
| 1607 | **PARAM. SAVE** | **0, 1** | **1** | **0** | |
| | Saves all altered parameters to permanent memory.<br>• Parameters altered through a fieldbus are not automatically saved to permanent memory. To save, you must use this parameter.<br>• If 1602 PARAMETER LOCK = 2 (NOT SAVED), parameters altered from the control panel are not saved. To save, you must use this parameter.<br>• If 1602 PARAMETER LOCK = 1 (OPEN), parameters altered from the control panel are stored immediately to permanent memory.<br>0 = DONE – Value changes automatically when all parameters are saved.<br>1 = SAVE – Saves altered parameters to permanent memory. | | | | |

| Group 16: System Controls | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1608 | **START ENABLE 1** | **-6…7** | **1** | **4** | |

Selects the source of the start enable 1 signal.
**Note:** Start enable functionality **differs** from the run enable functionality.

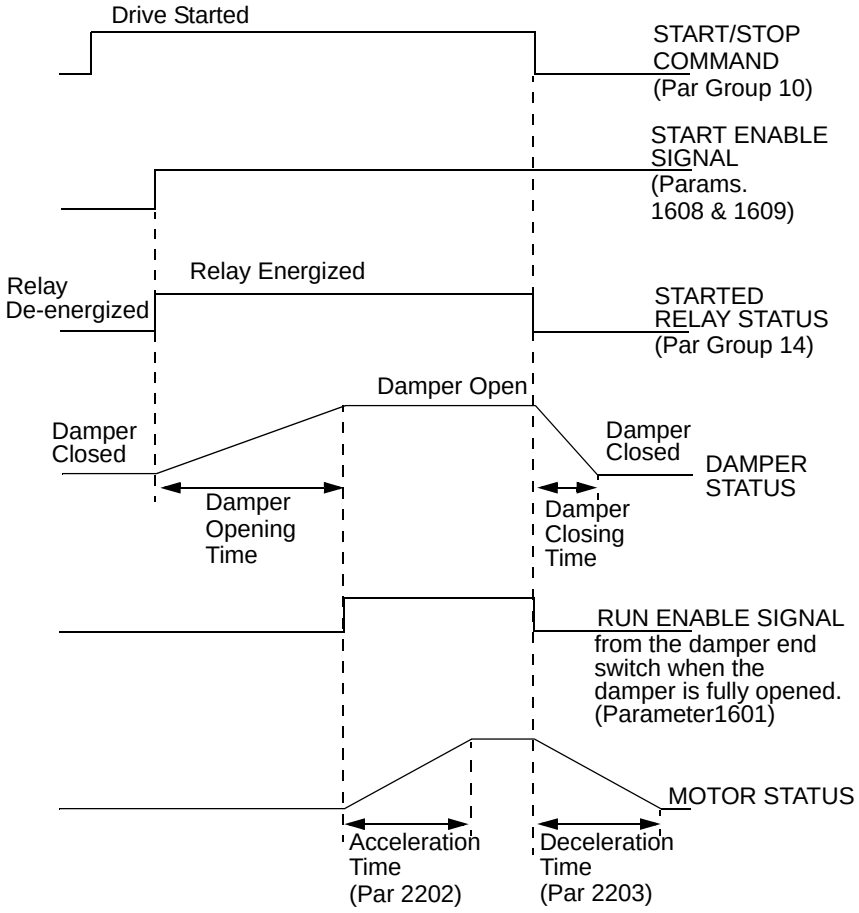
0 = NOT SEL – Allows the drive to start without an external start enable signal.
1 = DI1 – Defines digital input DI1 as the start enable 1 signal.
– This digital input must be activated for start enable 1 signal.
– If the voltage drops and de-activates this digital input, the drive will coast to stop and show alarm 2021 on panel display. The drive will not start until start enable 1 signal resumes.

2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the start enable 1 signal.
– See DI1 above.

7 = COMM – Assigns the fieldbus Command Word as the source for the start enable 1 signal.
– Bit 2 of the Command word 2 (parameter 0302) activates the start disable 1 signal.
– See fieldbus user's manual for detailed instructions.

(-1) = DI1(INV) – Defines an inverted digital input DI1 as the start enable 1 signal.

(-2)…(-6) = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the start enable 1 signal.
– See DI1(INV) above.



| Group 16: System Controls | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 1609 | **START ENABLE 2** | **-6…7** | **1** | **0** | |
| | Selects the source of the start enable 2 signal.<br>**Note:** Start enable functionality **differs** from the run enable functionality.<br><br>0 = NOT SEL – Allows the drive to start without an external start enable signal.<br>1 = DI1 – Defines digital input DI1 as the start enable 2 signal. This digital input must be activated for start enable 2 signal. If the voltage drops and de-activates this digital input, the drive will coast to stop and show alarm 2022 on panel display. The drive will not start until start enable 2 signal resumes.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the start enable 2 signal. See DI1 above.<br>7 = COMM – Assigns the fieldbus Command Word as the source for the start enable 2 signal. Bit 3 of the Command word 2 (parameter 0302) activates the start disable 2 signal. See fieldbus user's manual for detailed instructions.<br>(-1) = DI1(INV) – Defines an inverted digital input DI1 as the start enable 2 signal.<br>(-2)…(-6) = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the start enable 2 signal. See DI1(INV) above. | | | | |

### Group 17: Override

This group defines the source for the override activation signal, the override speed/ frequency and pass code and how the override is enabled and disabled.

When override DI is activated, the drive stops and then accelerates to the preset speed or frequency. When the DI is deactivated the drive stops and reboots. If the start command, run enable and start enables are active in the AUTO mode the drive starts automatically and continues normally after override mode. In the HAND mode the drive returns to OFF mode.

When override is active:

- Drive runs at preset speed
- Drive ignores all keypad commands
- Drive ignores all commands from communication links
- Drive ignores all digital inputs except override activation/deactivation, RUN ENABLE and START ENABLE
- Drive displays alarm message "2020 OVERRIDE MODE"

The following faults are ignored:

| | |
|---|---|
| 3 | DEVICE OVERTEMP |
| 5 | OVERLOAD |
| 6 | DC UNDERVOLT |
| 7 | AI1 LOSS |
| 8 | AI2 LOSS |
| 9 | MOTOR TEMP |
| 10 | PANEL LOSS |
| 12 | MOTOR STALL |
| 14 | EXTERNAL FLT 1 |
| 15 | EXTERNAL FLT 2 |
| 17 | UNDERLOAD |
| 18 | THERM FAIL |
| 21 | CURR MEAS |
| 22 | SUPPLY PHASE |
| 24 | OVERSPEED |
| 28 | SERIAL 1 ERR |
| 29 | EFB CONFIG FILE |
| 30 | FORCE TRIP |
| 31 | EFB 1 |
| 32 | EFB 2 |
| 33 | EFB 3 |
| 34 | MOTOR PHASE |
| 1001 | PAR PFC REFNEG |

| | |
|---|---|
| 1002 | PAR PFC IOCONF |
| 1003 | PAR AI SCALE |
| 1004 | PAR AO SCALE |
| 1006 | PAR EXTROMISSING |
| 1007 | PAR FBUSMISSING |
| 1008 | PAR PFCWOSCALAR |

*Commissioning the Override Mode:*

1. Enter the parameters in all groups as needed, except group 17.
2. Select the digital input that will activate override mode P1701.
3. Enter the frequency or speed reference for override mode, P1702 and P1703, according to the motor control mode P9904.
4. Enter the pass code P1704 (358).
5. Enable the override mode P1705.

*Changing the Override Parameters:*

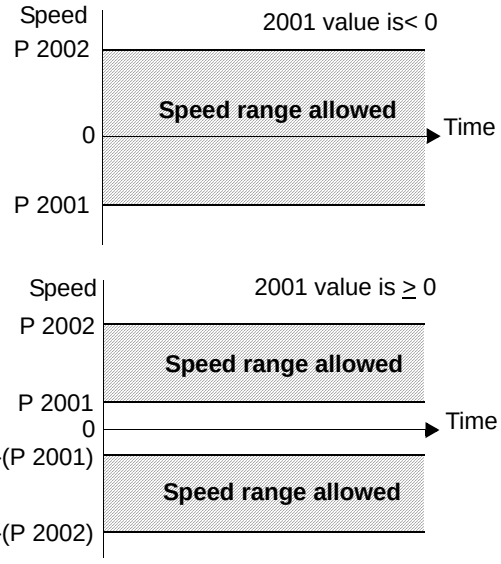
1. If override mode is already enabled, disable it:
   - Enter the pass code P1704.
   - Disable the override mode P1705.
2. If needed, load the override parameter set P9902.
3. Change the parameters as needed, except group 17.
4. Change the parameters in group 17 as needed:
   - Digital input for override mode P1701.
   - Frequency or speed reference, P1702 or P1703.
5. Enter the pass code P1704.
6. Enable the override mode P1705. The drive replaces the override parameter set with new values of all parameters.

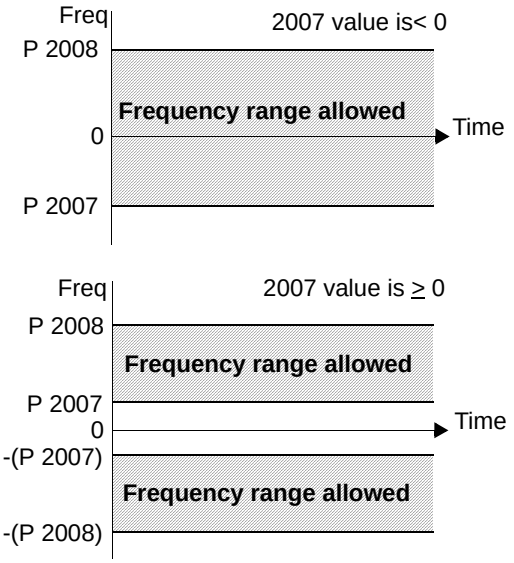
| Group 17: Override | | | | |
|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **DefaultS** |
| 1701 | **OVERRIDE SEL** | **-6…6** | **1** | **0** |
| | Selects the source of the override activation signal.<br>0 = NOT SEL – Override activation signal not selected.<br>1 = DI1 – Defines digital input DI1 as the override activation signal.<br>• This digital input must be activated for override activation signal.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the override activation signal.<br>• See DI1 above.<br>(-1) = DI1(INV) – Defines an inverted digital input DI1 as the override activation signal.<br>(-2)…(-6) = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the override activation signal.<br>• See DI1(INV) above. | | | |
| 1702 | **OVERRIDE FREQ** | **-500…500 Hz** | **0.1** | **0.0** |
| | Defines a preset frequency for the override.<br>**Note!** Set this value if motor control mode (Par. 9904) is SCALAR: FREQ (3). | | | |

| Group 17: Override | | | | |
|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **DefaultS** |
| 1703 | **OVERRIDE SPEED**<br>Defines a preset speed for the override.<br>Note! Set this value if motor control mode (Par.9904) is VECTOR: SPEED (1). | **-30.000…30.000 rpm** | **1** | **0** |
| 1704 | **OVERR PASS CODE**<br>Entering the correct override pass code unlocks parameter 1705 for one change.<br>• Enter the pass code always before changing the value of the parameter 1705.<br>• See parameter 1705 below.<br>• The pass code is 358.<br>• The entry reverts back to zero automatically. | **0…65535** | **1** | **0** |
| 1705 | **OVERRIDE ENABLE**<br>Selects whether the override is enabled or disabled.<br>0 = OFF – Override disabled.<br>1 = ON – Override enabled.<br>• When enabled, the drive stores the values of all parameters into an override parameter set (see parameter 9902) and the parameters in Group 17 will be write protected (except parameter 1704). To change the other parameters in the Group 17, override has to be disabled. | **0…1** | **1** | **0** |

### Group 20: Limits

This group defines minimum and maximum limits to follow in driving the motor – speed, frequency, current, torque, etc.

| Group 20: Limits | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 2001 | **MINIMUM SPEED** | **-30000…30000 rpm** | **1 rpm** | **0 rpm** | ✓ |
| | Defines the minimum speed (rpm) allowed.<br>• A positive (or zero) minimum speed value defines two ranges, one positive and one negative.<br>• A negative minimum speed value defines one speed range.<br>• See figure.<br>  | | | | |
| 2002 | **MAXIMUM SPEED** | **0…30000 rpm** | **1 rpm** | **1800 (US)** | ✓ |
| | Defines the maximum speed (rpm) allowed. | | | | |
| 2003 | **MAX CURRENT** | **0.0… 1.3 * $I_{2N}$** | **0.1 A** | **1.3 * $I_{2N}$** | ✓ |
| | Defines the maximum output current (A) supplied by the drive to the motor. | | | | |
| 2006 | **UNDERVOLT CTRL** | **0, 1** | **1** | **1** | |
| | Sets the DC undervoltage controller on or off. When on:<br>• If the DC bus voltage drops due to loss of input power, the undervoltage controller decreases the motor speed in order to keep the DC bus voltage above the lower limit.<br>• When the motor speed decreases, the inertia of the load causes regeneration back into the drive, keeping the DC bus charged, and preventing an undervoltage trip.<br>• The DC undervoltage controller increases power loss ride-through on systems with a high inertia, such as a centrifuge or a fan.<br>0 = DISABLE – Disables controller.<br>1 = ENABLE(TIME) – Enables controller without a maximum time limit for operation. | | | | |

| Group 20: Limits | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 2007 | **MINIMUM FREQ**<br>Defines the minimum limit for the drive output frequency.<br>• A positive or zero minimum speed value defines two ranges, one positive and one negative.<br>• A negative minimum speed value defines one speed range. See figure.<br>**Note!** Keep MINIMUM FREQ ≤ MAXIMUM FREQ.<br>  | **-500.0…500.0 Hz** | **0.1 Hz** | **0.0 Hz** | ✓ |
| 2008 | **MAXIMUM FREQ**<br>Defines the maximum limit for the drive output frequency. | **0.0…500.0 Hz** | **0.1 Hz** | **60.0 Hz (US)** | ✓ |
| 2013 | **MIN TORQUE SEL**<br>Defines control of the selection between two minimum torque limits (2015 MIN TORQUE 1 and 2016 MIN TORQUE 2).<br>0 = MIN TORQUE 1 – Selects 2015 MIN TORQUE 1 as the minimum limit used.<br>1 = DI1 – Defines digital input DI1 as the control for selecting the minimum limit used.<br>• Activating the digital input selects MIN TORQUE 2 value.<br>• De-activating the digital input selects MIN TORQUE 1 value.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for selecting the minimum limit used.<br>• See DI1 above.<br>7 = COMM – Defines bit 15 of the Command Word 1 as the control for selecting the minimum limit used.<br>• The Command Word is supplied through fieldbus communication.<br>The Command Word is a parameter 0301.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as the control for selecting the minimum limit used.<br>• Activating the digital input selects MIN TORQUE 1 value.<br>• De-activating the digital input selects MIN TORQUE 2 value.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for selecting the minimum limit used.<br>• See DI1(INV) above. | **-6…7** | **1** | **0** | |
| 2014 | **MAX TORQUE SEL**<br>Defines control of the selection between two maximum torque limits (2017 MAX TORQUE 1 and 2018 MAX TORQUE 2).<br>0 = MAX TORQUE 1 – Selects 2017 MAX TORQUE 1 as the maximum limit used.<br>1 = DI1 – Defines digital input DI1 as the control for selecting the maximum limit used.<br>Activating the digital input selects MAX TORQUE 2 value.<br>De-activating the digital input selects MAX TORQUE 1 value.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for selecting the maximum limit used.<br>• See DI1 above.<br>7 = COMM – Defines bit 15 of the Command Word 1 as the control for selecting the maximum limit used.<br>• The Command Word is supplied through fieldbus communication.<br>• The Command Word is a parameter 0301.<br>-1 = DI1(INV) – Defines an inverted digital input di1 as the control for selecting the maximum limit used.<br>• Activating the digital input selects MAX TORQUE 1 value.<br>• De-activating the digital input selects MAX TORQUE 2 value.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for selecting the maximum limit used.<br>• See DI1(INV) above. | **-6…7** | **1** | **0** | |

| Group 20: Limits | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 2015 | **MIN TORQUE 1** | **-600.0%…0.0%** | **0.1%** | **-300.0%** | |
| | Sets the first minimum limit for torque (%). Value is a percent of the motor nominal torque. | | | | |
| 2016 | **MIN TORQUE 2** | **-600.0%…0.0%** | **0.1%** | **-300.0%** | |
| | Sets the second minimum limit for torque (%). Value is a percent of the motor nominal torque. | | | | |
| 2017 | **MAX TORQUE 1** | **0.0%…600.0%** | **0.1%** | **300.0%** | |
| | Sets the first maximum limit for torque (%). Value is a percent of the motor nominal torque. | | | | |
| 2018 | **MAX TORQUE 2** | **0.0%…600.0%** | **0.1%** | **300.0%** | |
| | Sets the second maximum limit for torque (%). Value is a percent of the motor nominal torque. | | | | |

## 21: Start/Stop

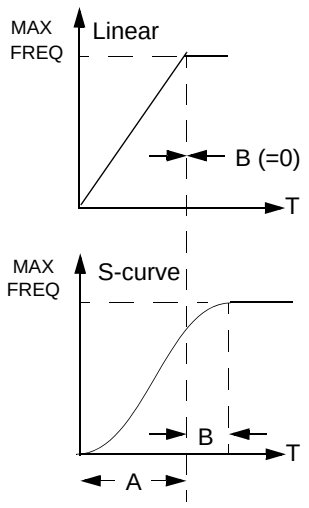
This group defines how the motor starts and stops. The ACH550 supports several start and stop modes.

| Group 21: Start/Stop | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 2101 | **START FUNCTION** | **1…5** | **1** | **1** | ✓ |
| | Selects the motor start method.<br>1 = AUTO – Selects the automatic start mode.<br>• VECTOR control modes: Optimal start in most cases. Flying start function to a rotating axis and start at zero speed.<br>• SCALAR: FREQ mode: Immediate start from zero frequency.<br>2 = DC MAGN – Selects the DC Magnetizing start mode.<br>**Note!** The DC Magnetizing start mode cannot start a rotating motor.<br>**Note!** The drive starts when the set pre-magnetizing time (param. 2103) has passed, even if motor magnetization is not complete.<br>• VECTOR control modes: Magnetizes the motor within the time determined by the parameter 2103 DC MAGN TIME using DC current. The normal control is released exactly after the magnetizing time. This selection guarantees the highest possible break-away torque.<br>• SCALAR SPEED mode: Magnetizes the motor within the time determined by the parameter 2103 DC MAGN TIME using DC current. The normal control is released exactly after the magnetizing time.<br>3 = SCALAR FLYSTART – Selects the flying start mode.<br>• VECTOR control modes: Not applicable.<br>• SCALAR control mode: The drive will automatically selects the correct output frequency to start a rotating motor. Useful if the motor is already rotating and the drive will start smoothly at the current frequency.<br>4 = TORQ BOOST – Selects the automatic torque boost mode (SCALAR SPEED mode only).<br>• May be necessary in drives with high starting torque.<br>• Torque boost is only applied at start, ending when output frequency exceeds 20 Hz or when output frequency is equal to reference.<br>• In the beginning the motor magnetizes within the time determined by the parameter 2103 DC MAGN TIME using DC current.<br>• See parameter 2110 TORQ BOOST CURR.<br>5 = FLYSTART + TORQ BOOST – Selects both the flying start and the torque boost mode (SCALAR SPEED mode only).<br>• Flying start routine is performed first and the motor is magnetized. If the speed is found to be zero, the torque boost is done. | | | | |
| 2102 | **STOP FUNCTION** | **1, 2** | **1** | **1** | |
| | Selects the motor stop method.<br>1 = COAST – Selects cutting off the motor power as the stop method. The motor coasts to stop.<br>2 = RAMP – Selects using a deceleration ramp<br>• Deceleration ramp is defined by 2203 DECELER TIME 1 or 2206 DECELER TIME 2 (whichever is active). | | | | |
| 2103 | **DC MAGN TIME** | **0.00…10.00 s** | **0.01 s** | **0.30 s** | |
| | Defines the pre-magnetizing time for the DC Magnetizing start mode.<br>• Use parameter 2101 to select the start mode.<br>• After the start command, the drive pre-magnetizes the motor for the time defined here, and then starts the motor.<br>• Set the pre-magnetizing time just long enough to allow full motor magnetization. Too long a time heats the motor excessively. | | | | |
| 2104 | **DC CURR CTL** | **0…2** | **-** | **0** | ✓ |
| | Selects whether DC current is used for braking.<br>0 = NOT SEL – Disables the DC current operation.<br>1 = DC BRAKING – Enables the DC Injection Braking.<br>• Enables DC Injection braking after modulation has stopped.<br>• If parameter 2102 STOP FUNCTION is 1 (COAST), braking is applied after start is removed.<br>• If parameter 2102 STOP FUNCTION IS 2 (RAMP), braking is applied after ramp. | | | | |
| 2106 | **DC CURR REF** | **0…100%** | **1%** | **30%** | |
| | Defines the DC current control reference as a percentage of parameter 9906 (MOTOR NOM CURR). | | | | |
| 2107 | **DC BRAKE TIME** | **0…250 s** | **0.1 s** | **0 s** | |
| | Defines the DC brake time after modulation has stopped, if parameter 2104 is 2 (DC BRAKING). | | | | |

| Group 21: Start/Stop | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 2108 | **START INHIBIT** | **0, 1** | **1** | **0** | ✓ |
| | Sets the Start inhibit function on or off. The Start inhibit function ignores a pending start command in any of the following situations (a new start command is required):<br>• A fault is reset.<br>• Run Enable (parameter 1601) activates while start command is active.<br>• Mode changes from local to remote.<br>• Mode changes from remote to local.<br>• Control switches from EXT1 to EXT2.<br>• Control switches from EXT2 to EXT1.<br>0 = OFF – Disables the Start inhibit function.<br>1 = ON – Enables the Start inhibit function. | | | | |
| 2109 | **EM STOP SEL** | **-6…6** | **1** | **0** | |
| | Defines control of the Emergency stop command. When activated:<br>• Emergency stop decelerates the motor using the emergency stop ramp (parameter 2208 EM DEC TIME).<br>• Requires an external stop command and removal of the emergency stop command before drive can restart.<br>0 = NOT SEL – Disables the Emergency stop function through digital inputs.<br>1 = DI1 – Defines digital input DI1 as the control for Emergency stop command.<br>• Activating the digital input issues an Emergency stop command.<br>• De-activating the digital input removes the Emergency stop command.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for Emergency stop command.<br>• See DI1 above.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as the control for Emergency stop command.<br>• De-activating the digital input issues an Emergency stop command.<br>• Activating the digital input removes the Emergency stop command.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for Emergency stop command.<br>• See DI1(INV) above. | | | | |
| 2110 | **TORQ BOOST CURR** | **0…300%** | **1** | **100%** | |
| | Sets the maximum supplied current during torque boost.<br>• See parameter 2101 START FUNCTION. | | | | |

## Group 22: Accel/Decel

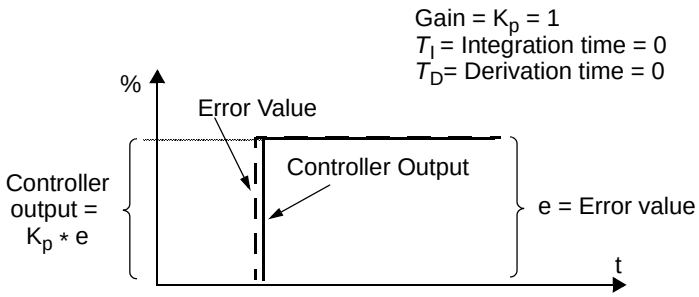
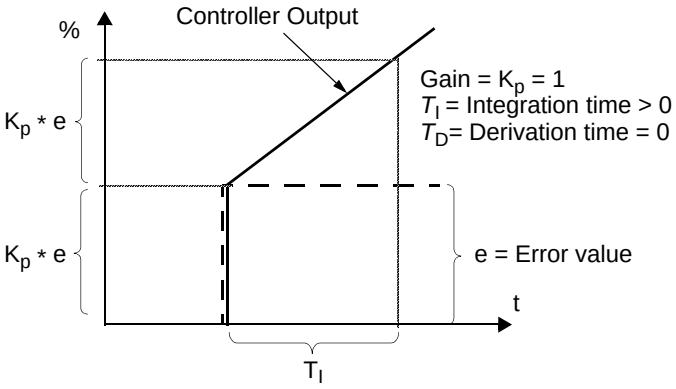
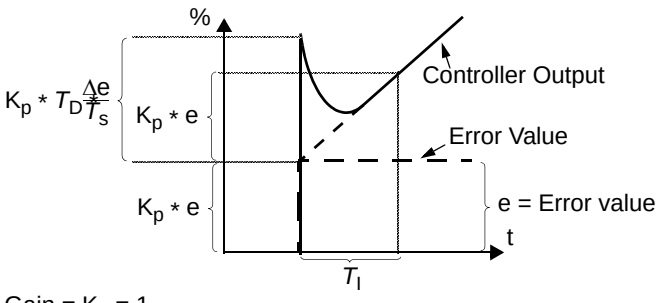
This group defines ramps that control the rate of acceleration and deceleration. You define these ramps as a pair, one for acceleration and one for deceleration. You can define two pairs of ramps and use a digital input to select one or the other pair.

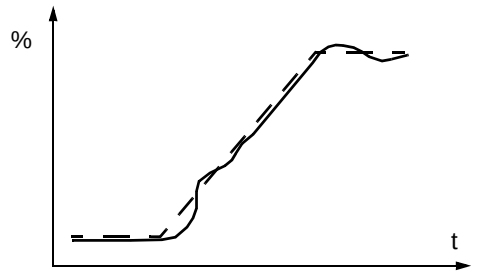
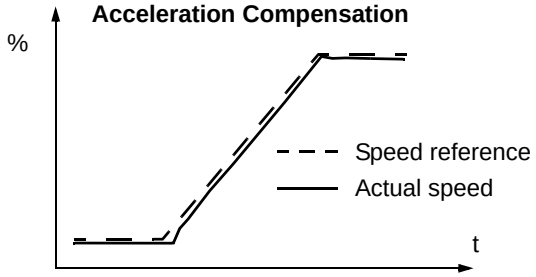
| Group 22: Accel/Decel | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 2201 | **ACC/DEC 1/2 SEL** | **-6…7** | **1** | **0** | |
| | Defines control for selection of acceleration/deceleration ramps.<br>• Ramps are defined in pairs, one each for acceleration and deceleration.<br>• See below for the ramp definition parameters.<br>0 = NOT SEL – Disables selection, the first ramp pair is used.<br>1 = DI1 – Defines digital input DI1 as the control for ramp pair selection.<br>• Activating the digital input selects ramp pair 2.<br>• De-activating the digital input selects ramp pair 1.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for ramp pair selection.<br>• See DI1 above.<br>7 = COMM – Defines serial communication as the control for ramp pair selection.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as the control for ramp pair selection.<br>• De-activating the digital input selects ramp pair 2<br>• Activating the digital input selects ramp pair 1.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for ramp pair selection.<br>• See DI1(INV) above. | | | | |
| 2202 | **ACCELER TIME 1** | **0.0…1800.0 s** | **0.1 s** | **30.0 s** | |
| | Sets the acceleration time for zero to maximum frequency for ramp pair 1. See A in figure.<br>• Actual acceleration time also depends on 2204 RAMP SHAPE.<br>• See 2008 MAXIMUM FREQUENCY. | | | | |
| 2203 | **DECELER TIME 1** | **0.0…1800.0 s** | **0.1 s** | **30.0 s** | |
| | Sets the deceleration time for maximum frequency to zero for ramp pair 1.<br>• Actual deceleration time also depends on 2204 RAMP SHAPE.<br>• See 2008 MAXIMUM FREQUENCY. | | | | |
| 2204 | **RAMP SHAPE 1** | **0...1000.0 s** | **0.1 s** | **0.0** | |
| | Selects the shape of the acceleration/deceleration ramp for ramp pair 1. See B in figure.<br>• Shape is defined as a ramp, unless additional time is specified here to reach the maximum frequency. A longer time provides a softer transition at each end of the slope. The shape becomes an s-curve.<br>• Rule of thumb: 1/5 is a suitable relation between the ramp shape time and the acceleration ramp time.<br>0.0 = LINEAR – Specifies linear acceleration/deceleration ramps for ramp pair 1.<br>0.1…1000.0 = S-CURVE – Specifies s-curve acceleration/deceleration ramps for ramp pair 1. | | | |  <br>A = 2202 ACCELERATION TIME<br>B = 2204 RAMP SHAPE |
| 2205 | **ACCELER TIME 2** | **0.0…1800.0 s** | **0.1 s** | **60.0 s** | |
| | Sets the acceleration time (s) for zero to maximum frequency for ramp pair 2. See 2002 ACCELER TIME 1. | | | | |
| 2206 | **DECELER TIME 2** | **0.0…1800.0 s** | **0.1 s** | **60.0 s** | |
| | Sets the deceleration time for maximum frequency to zero for ramp pair 2. See 2003 DECELER TIME 1. | | | | |

| Group 22: Accel/Decel | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 2207 | **RAMP SHAPE 2** | **0…1000.0 s** | **0.1 s** | **0.0** | |
| | Selects the shape of the acceleration/deceleration ramp for ramp pair 2. See 2004 RAMP SHAPE 1. | | | | |
| 2208 | **EM DEC TIME** | **0.0…1800 s** | **0.1 s** | **1.0 s** | |
| | Sets the deceleration time for maximum frequency to zero for an emergency.<br>• See parameter 2109 EM STOP SEL.<br>• Ramp is linear. | | | | |
| 2209 | **RAMP INPUT 0** | **-6…6** | **1** | **0** | |
| | Defines control for forcing the ramp input to 0.<br>0 = NOT SEL –<br>1 = DI1 – Defines digital input DI1 as the control for forcing the ramp input to 0.<br>• Activating the digital input forces ramp input to 0. Ramp output will ramp to 0 according to the currently used ramp time, after which it will stay at 0.<br>• De-activating the digital input: ramp resumes normal operation.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for forcing the ramp input to 0.<br>• See DI1 above.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as the control for forcing the ramp input to 0.<br>• De-activating the digital input forces ramp input to 0.<br>• Activating the digital input: ramp resumes normal operation.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for forcing the ramp function generator input to 0.<br>• See DI1(INV) above. | | | | |

## Group 23: Speed Control

This group defines variables used for speed control operation.

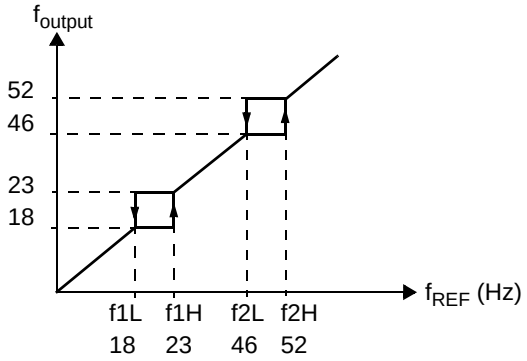
| Group 23: Speed Control | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 2301 | **PROP GAIN** | **0.00…200.00** | **0.01** | **3.00** | |
| | Sets the relative gain for the speed controller.<br>• Larger values may cause speed oscillation.<br>• The figure shows the speed controller output after an error step (error remains constant).<br>**Note!** You can use parameter 2305, AUTOTUNE RUN, to automatically set proportional gain. | | |  | |
| 2302 | **INTEGRATION TIME** | **0.00…600.00 s** | **0.01 s** | **2.50** | |
| | Sets the integration time for the speed controller.<br>• The integration time defines the rate at which the controller output changes for a constant error value.<br>• Shorter integration times correct continuous errors faster.<br>• Control becomes unstable if the integration time is too short.<br>• The figure shows the speed controller output after an error step (error remains constant).<br>**Note!** You can use parameter 2305, AUTOTUNE RUN, to automatically set proportional gain. | | |  | |
| 2303 | **DERIVATION TIME** | **0…10000 ms** | **1 ms** | **0** | |
| | Sets the derivation time for the speed controller.<br>• Derivative action makes the control more responsive to error value changes.<br>• The longer the derivation time, the more the speed controller output is boosted during the change.<br>• If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller.<br>The figure shows the speed controller output after an error step when the error remains constant. | | |  <br>Gain = $K_p$ = 1<br>$T_I$ = Integration time > 0<br>$T_D$= Derivation time > 0<br>$T_s$= Sample time period = 2 ms<br>$\Delta$e = Error value change between two samples | |

| Group 23: Speed Control | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 2304 | **ACC COMPENSATION** | **0.00…600.00 s** | **0.01 s** | **0.00** | |
| | Sets the derivation time for acceleration compensation.<br>• Adding a derivative of the reference to the output of the speed controller compensates for inertia during acceleration.<br>• 2303 DERIVATION TIME describes the principle of derivative action.<br>• Rule of thumb: Set this parameter between 50 and 100% of the sum of the mechanical time constants for the motor and the driven machine.<br>• The figure shows the speed responses when a high inertia load is accelerated along a ramp.<br>**No Acceleration Compensation**<br>  <br>**Acceleration Compensation**<br>  | | | | |
| 2305 | **AUTOTUNE RUN** | **0…1** | **1** | **0** | |
| | Starts automatic tuning of the speed controller.<br>0 = OFF– Disables the Autotune creation process. (Does not disable the operation of Autotune settings.)<br>1 = ON – Activates speed controller autotuning. Automatically reverts to OFF.<br>Procedure:<br>Note! The motor load must be connected.<br>• Run the motor at a constant speed of 20 to 40% of the rated speed.<br>• Change the autotuning parameter 2305 to ON.<br>The drive:<br>• Accelerates the motor.<br>• Calculates values for proportional gain and integration time.<br>• Changes parameters 2301 and 2302 to these values.<br>• Resets 2305 to OFF. | | | | |

### Group 25: Critical Speeds

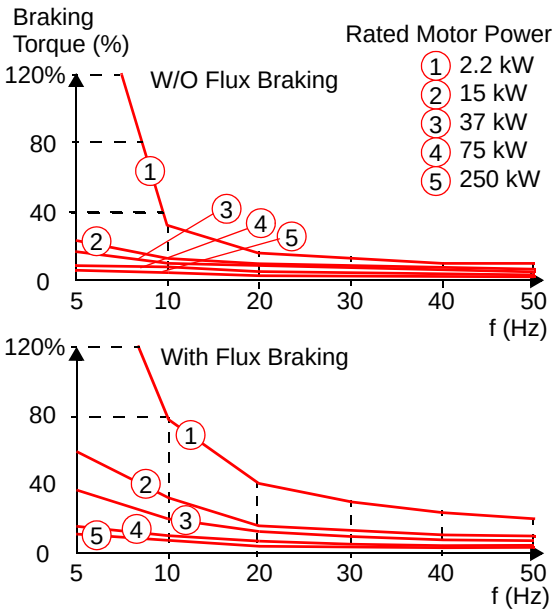
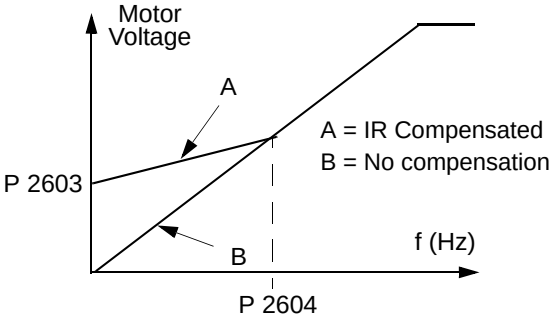
This group defines up to three critical speeds or ranges of speeds that are to be avoided due, for example, to mechanical resonance problems at certain speeds.

| Group 25: SCritical Speeds | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 2501 | **CRIT SPEED SEL**<br>Sets the critical speeds function on or off. The critical speed function avoids specific speed ranges.<br>0 = OFF – Disables the critical speeds function.<br>1 = ON – Enables the critical speeds function.<br>Example: To avoid speeds at which a fan system vibrates badly:<br>• Determine problem speed ranges. Assume they are found to be: 18…23 Hz and 46…52 Hz.<br>• Set 2501 CRIT SPEED SEL = 1.<br>• Set 2502 CRIT SPEED 1 LO = 18 Hz.<br>• Set 2503 CRIT SPEED 1 HI = 23 Hz.<br>• Set 2504 CRIT SPEED 2 LO = 46 Hz.<br>• Set 2505 CRIT SPEED 2 HI = 52 Hz. | **0, 1** | **1** | **0** | |
| 2502 | **CRIT SPEED 1 LO**<br>Sets the minimum limit for critical speed range 1.<br>• The value must be less than or equal to 2503 CRIT SPEED 1 HI.<br>• Units are rpm, unless 9904 MOTOR CTRL MODE = 3 (SCALAR SPEED), then units are Hz. | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **0 rpm / 0.0 Hz** | |
| 2503 | **CRIT SPEED 1 HI**<br>Sets the maximum limit for critical speed range 1.<br>• The value must be greater than or equal to 2502 CRIT SPEED 1 LO.<br>• Units are rpm, unless 9904 MOTOR CTRL MODE = 3 (SCALAR SPEED), then units are Hz. | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **0 rpm / 0.0 Hz** | |
| 2504 | **CRIT SPEED 2 LO**<br>Sets the minimum limit for critical speed range 2.<br>• See parameter 2502. | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **0 rpm / 0.0 Hz** | |
| 2505 | **CRIT SPEED 2 HI**<br>Sets the maximum limit for critical speed range 2.<br>• See parameter 2503. | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **0 rpm / 0.0 Hz** | |
| 2506 | **CRIT SPEED 3 LO**<br>Sets the minimum limit for critical speed range 3.<br>• See parameter 2502. | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **0 rpm / 0.0 Hz** | |
| 2507 | **CRIT SPEED 3 HI**<br>Sets the maximum limit for critical speed range 3.<br>• See parameter 2503. | **0…30000 rpm / 0.0…500.0 Hz** | **1 rpm / 0.1 Hz** | **0 rpm / 0.0 Hz** | |



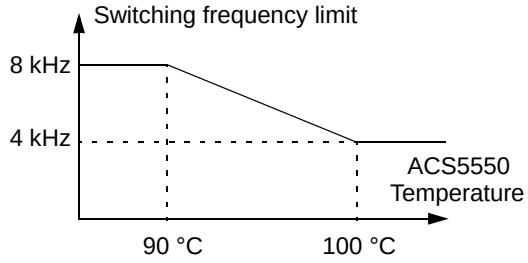
## Group 26: Motor Control

This group provides controls for fine-tuning the motor control.

<table>
<tr><th colspan="6">Group 26: Motor Control</th></tr>
<tr><th>Code</th><th>Description</th><th>Range</th><th>Resolution</th><th>Default</th><th>S</th></tr>
<tr><td>2601</td><td>FLUX OPTIMIZATION</td><td>0…1</td><td>1</td><td>1</td><td></td></tr>
<tr><td></td><td colspan="5">Changes the magnitude of the flux depending on the actual load. Flux Optimization can reduce the total energy consumption and noise, and should be enabled for drives that usually operate below nominal load.<br>0 = OFF – Disables the feature.<br>1 = ON – Enables the feature.</td></tr>
<tr><td>2602</td><td>FLUX BRAKING</td><td>0…1</td><td>1</td><td>0</td><td></td></tr>
<tr><td></td><td colspan="5">Provides faster deceleration by raising the level of magnetization in the motor when needed, instead of limiting the deceleration ramp. By increasing the flux in the motor, the energy of the mechanical system is changed to thermal energy in the motor.<br>0 = OFF – Disables the feature.<br>1 = ON – Enables the feature.<br> 
</td></tr>
<tr><td>2603</td><td>IR COMP VOLT</td><td>0.0…100.0 V</td><td>0.1</td><td>0.0</td><td></td></tr>
<tr><td></td><td colspan="5">Sets the IR compensation voltage used for 0 Hz.<br>• Requires parameter 9904 MOTOR CTRL MODE = 3 (SCALAR SPEED).<br>• Keep IR compensation as low as possible to prevent overheating.<br>• Typical IR compensation values are:<br> 

<table>
<tr><th colspan="6">380…480 V Units</th></tr>
<tr><td>$P_N$ (kW)</td><td>3</td><td>7.5</td><td>15</td><td>37</td><td>132</td></tr>
<tr><td>IR comp (V)</td><td>21</td><td>18</td><td>15</td><td>10</td><td>4</td></tr>
</table>
IR Compensation<br>• When enabled, IR Compensation provides an extra voltage boost to the motor at low speeds. Use IR Compensation, for example, in applications that require a high breakaway torque.</td></tr>
<tr><td>2604</td><td>IR COMP FREQ</td><td>0…100%</td><td>1</td><td>80</td><td></td></tr>
<tr><td></td><td colspan="5">Sets the frequency at which IR compensation is 0 V (in % of motor frequency).</td></tr>
<tr><td>2605</td><td>U/f RATIO</td><td>1, 2</td><td>1</td><td>2</td><td></td></tr>
<tr><td></td><td colspan="5">Selects the form for the U/f (voltage to frequency) ratio below field weakening point.<br>1 = LINEAR – Preferred for constant torque applications.<br>2 = SQUARED – Preferred for centrifugal pump and fan applications. (Square is more silent for most operating frequencies.)</td></tr>
</table>

| Group 26: Motor Control | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 2606 | **SWITCHING FREQ** | **1, 4, 8 kHz** | **-** | **4 kHz** | |
| | Sets the switching frequency for the drive.<br>• Higher switching frequencies mean less noise. | | | | |
| 2607 | **SW FREQ CTRL** | **0, 1** | **-** | **1** | |
| | The switching frequency may be reduced if the ACH550 internal temperature rises above 90 °C. See Figure. This function allows the highest possible switching frequency to be used based on operating conditions. Higher switching frequency results in lower acoustic noise.<br>0 = OFF – The function is disabled.<br>1 = ON – The switching frequency is limited according to the figure. | | | | |
| 2608 | **SLIP COMP RATIO** | **0…200%** | **1** | **0** | |
| | Sets gain for slip compensation (in %).<br>• A squirrel-cage motor slips under load. Increasing the frequency as the motor torque increases compensates for the slip.<br>• Requires parameter 9904 MOTOR CTRL MODE = SCALAR SPEED.<br>0 = No slip compensation.<br>1…200 = Increasing slip compensation. 100% means full slip compensation. | | | | |



### Group 29: Maintenance Trig

This group contains usage levels and trigger points. When usage reaches the set trigger point, a notice displayed on the control panel signals that maintenance is due.

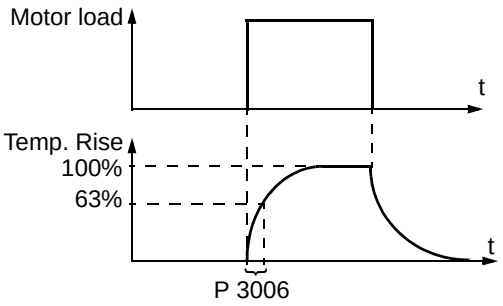
| Group 29: Maintenance Trig | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 2901 | **COOLING FAN TRIG**<br>Sets the trigger point for the drive's cooling fan counter.<br>• 0.0 = NOT SEL | **0.0…6553.5 kh** | **0.1 kh** | **0.0** | |
| 2902 | **COOLING FAN ACT**<br>Defines the actual value of the drive's cooling fan counter.<br>• The parameter is reset by writing 0.0 to it. | **0.0…6553.5 kh** | **0.1 kh** | **0.0** | |
| 2903 | **REVOLUTION TRIG**<br>Sets the trigger point for the motor's accumulated revolutions counter.<br>• 0.0 = NOT SEL | **0…65535 MRev** | **1 MRev** | **0** | |
| 2904 | **REVOLUTION ACT**<br>Defines the actual value of the motor's accumulated revolutions counter.<br>• The parameter is reset by writing 0 to it. | **0…65535 MRev** | **1 MRev** | **0** | |
| 2905 | **RUN TIME TRIG**<br>Sets the trigger point for the drive's run time counter.<br>• 0.0 = NOT SEL | **0.0…6553.5 kh** | **0.1 kh** | **0.0** | |
| 2906 | **RUN TIME ACT**<br>Defines the actual value of the drive's run time counter.<br>• The parameter is reset by writing 0.0 to it. | **0.0…6553.5 kh** | **0.1 kh** | **0.0** | |
| 2907 | **USER MWh TRIG**<br>Sets the trigger point for the drive's accumulated power consumption (in megawatt hours) counter.<br>• 0.0 = NOT SEL | **0.0…6553.5 MWh** | **0.1 MWh** | **0.0** | |
| 2908 | **USER MWh ACT**<br>Defines the actual value of the drive's accumulated power consumption (in megawatt hours) counter.<br>• The parameter is reset by writing 0.0 to it. | **0.0…6553.5 MWh** | **0.1 MWh** | **0.0** | |

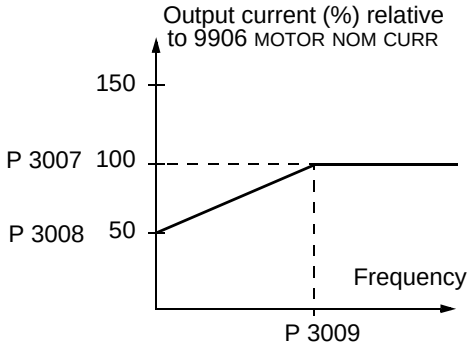
## Group 30: Fault Functions

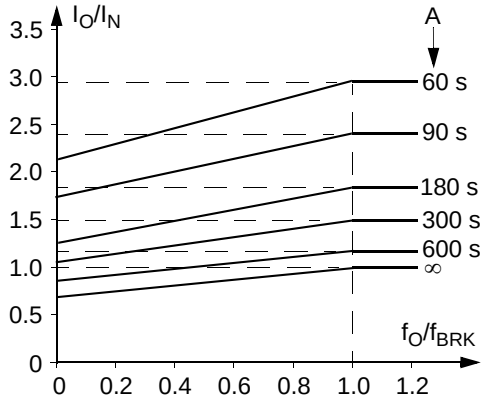
This group defines situations that the drive should recognize as potential faults and defines how the drive should respond if the fault is detected.

| Group 30: Fault Functions | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3001 | **AI<MIN FUNCTION** | **0…3** | **1** | **0** | |
| | Defines the drive response if the analog input (AI) signal drops below the fault limits and AI is used in reference chain.<br>• 3021 AI1 FAULT LIMIT and 3022 AI2 FAULT LIMIT set the minimum limits<br>0 = NOT SEL – No response.<br>1 = FAULT – Displays a fault (7, AI1 LOSS or 8, AI2 LOSS) and the drive coasts to stop.<br>2 = CONST SP 7 – Displays a warning (2006, AI1 LOSS or 2007, AI2 LOSS) and sets speed using 1208 CONST SPEED 7.<br>3 = LAST SPEED – Displays a warning (2006, AI1 LOSS or 2007, AI2 LOSS) and sets speed using the last operating level. This value is the average speed over the last 10 seconds.<br>**Warning! If you select CONST SP 7 or LAST SPEED, make sure that continued operation is safe when the analog input signal is lost.** | | | |
| 3002 | **PANEL COMM ERR** | **1…3** | **1** | **1** | |
| | Defines the drive response to a control panel communication error.<br>1 = FAULT – Displays a fault (10, PANEL LOSS) and the drive coasts to stop.<br>2 = CONST SP 7 – Displays a warning (2008, PANEL LOSS) and sets speed using 1208 CONST SPEED 7.<br>3 = LAST SPEED – Displays a warning (2008, PANEL LOSS) and sets speed using the last operating level. This value is the average speed over the last 10 seconds.<br>**Warning! If you select CONST SP 7 or LAST SPEED, make sure that continued operation is safe when the control panel communication is lost.** | | | | |
| 3003 | **EXTERNAL FAULT 1** | **-6…6** | **1** | **0** | |
| | Defines the External Fault 1 signal input and the drive response to an external fault.<br>0 = NOT SEL – External fault signal is not used.<br>1 = DI1 – Defines digital input DI1 as the external fault input.<br>• Activating the digital input indicates a fault. The drive displays a fault (14, EXTERNAL FAULT 1) and the drive coasts to stop.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the external fault input.<br>• See DI1 above.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as the external fault input.<br>• De-activating the digital input indicates a fault. The drive displays a fault (14, EXTERNAL FAULT 1) and the drive coasts to stop.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the external fault input.<br>• See DI1(INV) above. | | | | |
| 3004 | **EXTERNAL FAULT 2** | **-6…6** | **1** | **0** | |
| | Defines the External Fault 2 signal input and the drive response to an external fault.<br>• See parameter 3003 above. | | | | |
| 3005 | **MOT THERM PROT** | **0, 2** | **1** | **1** | |
| | Defines the drive response to motor overheating.<br>0 = NOT SEL – No response and/or motor thermal protection not set up.<br>1 = FAULT – When the calculated motor temperature exceeds 90 C, displays a warning (2010, MOT OVERTEMP). When the calculated motor temperature exceeds 110 C displays a fault (9, MOT OVERTEMP) and the drive coasts to stop.<br>2 = WARNING – When the calculated motor temperature exceeds 90 C, displays a warning (2010, MOT OVERTEMP). | | | | |

| Group 30: Fault Functions | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3006 | **MOT THERM TIME**<br>Sets the motor thermal time constant for the motor temperature model.<br>• This is the time required for the motor to reach 63% of the final temperature with steady load.<br>• For thermal protection according to UL requirements for NEMA class motors, use the rule of thumb: MOTOR THERM TIME equals 35 times t6, where t6 (in seconds) is specified by the motor manufacturer as the time that the motor can safely operate at six times its rated current.<br>• The thermal time for a Class 10 trip curve is 350 s, for a Class 20 trip curve 700 s, and for a Class 30 trip curve 1050 s. | **256…9999 s** | **1** | **1050 s** | |
| 3007 | **MOT LOAD CURVE**<br>Sets the maximum allowable operating load of the motor.<br>• When set to 100%, the maximum allowable load is equal to the value of Start-up Data parameter 9906 MOTOR NOM CURRENT.<br>• Adjust the load curve level if the ambient temperature differs from nominal. | **50…150%** | **1** | **100%** | |
| 3008 | **ZERO SPEED LOAD**<br>Sets the maximum allowable current at zero speed.<br>• Value is relative to 9906 MOTOR NOM CURR. | **25…150%** | **1** | **70%** | |
| 3009 | **BREAK POINT FREQ**<br>Sets the break point frequency for the motor load curve.<br>**Example:** Thermal protection trip times when parameters 3006 MOT THERM TIME, 3007 MOT LOAD CURVE and 3008 ZERO SPEED LOAD have default values. | **1…250 Hz** | **1** | **35 Hz** | |

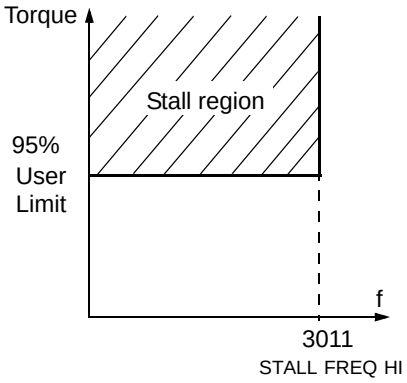


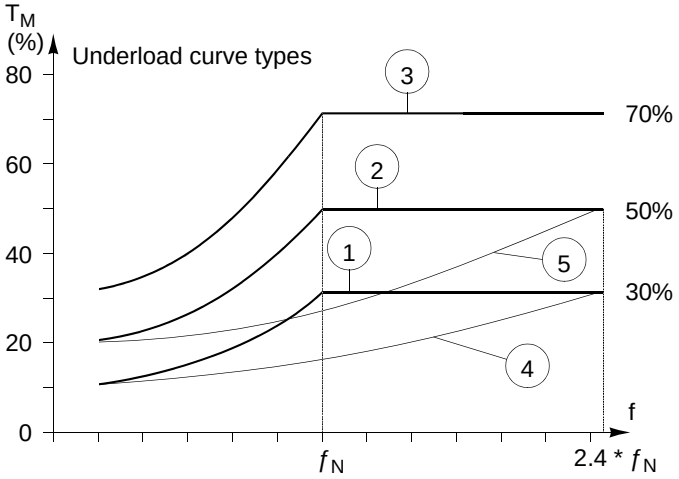




$I_O$ = Output current
$I_N$ = Nominal motor current
$f_O$ = Output frequency
$f_{BRK}$ = Break point frequency
A = Trip time

| Group 30: Fault Functions | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3010 | **STALL FUNCTION** | **0…2** | **1** | **0** | |
| | This parameter defines the operation of the Stall function. This protection is active if the drive operates in the stall region (see figure) for the time defined by 3012 STALL TIME. The "User Limit" is defined in Group 20 by 2017 MAX TORQUE 1, 2018 MAX TORQUE 2, or the limit on the COMM input.<br>0 = NOT SEL – Stall protection is not used.<br>1 = FAULT – When the drive operates in the stall region for the time set by 3012 STALL TIME:<br>• The drive coasts to stop.<br>• A fault indication is displayed.<br>2 = WARNING – When the drive operates in the stall region for the time set by 3012 STALL TIME:<br>• A warning indication is displayed.<br>• The warning disappears when the drive is out of the stall region for half the time set by parameter 3012 STALL TIME. | | | | |
| 3011 | **STALL FREQUENCY** | **0.5…50.0 Hz** | **0.1 Hz** | **20.0 Hz** | |
| | This parameter sets the frequency value for the Stall function. Refer to Figure. | | | | |
| 3012 | **STALL TIME** | **10…400 s** | **1 s** | **20 s** | |
| | This parameter sets the time value for the Stall function. | | | | |
| 3013 | **UNDERLOAD FUNCTION** | **0…2** | **-** | **0** | |
| | Removal of motor load may indicate a process malfunction. The protection is activated if:<br>• The motor torque drops below the load curve selected by parameter 3015 UNDERLOAD CURVE.<br>• This condition has lasted longer than the time set by parameter 3014 UNDERLOAD TIME.<br>• Output frequency is higher than 10% of the nominal frequency.<br>0 = NOT SEL – Underload protection is not used.<br>1 = FAULT – When the protection is activated the drive coasts to stop. A fault indication is displayed.<br>2 = WARNING – A warning indication is displayed. | | | | |
| 3014 | **UNDERLOAD TIME** | **10…400 s** | **1 s** | **20 s** | |
| | Time limit for underload protection. | | | | |
| 3015 | **UNDERLOAD CURVE** | **1…5** | **1** | **1** | |
| | This parameter provides five selectable curves shown in the figure.<br>• If the load drops below the set curve for longer than the time set by parameter 3014, the underload protection is activated.<br>• Curves 1…3 reach maximum at the motor rated frequency set by parameter 9907 MOTOR NOM FREQ.<br>• $T_M$ = nominal torque of the motor.<br>• $f_N$ = nominal frequency of the motor. | | | | |
| 3017 | **EARTH FAULT** | **0…1** | **1** | **1** | |
| | Defines the drive response if the drive detects a ground fault in the motor or motor cables.<br>0 = DISABLE – No response.<br>**1 =** ENABLE **– Displays a fault (16, EARTH FAULT) and the drive coasts to stop.** | | | | |

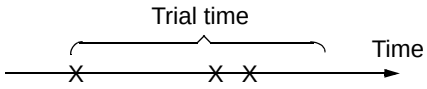


| Group 30: Fault Functions | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3018 | **COMM FAULT FUNC** | **0…3** | **1** | **0** | |
| | Defines the drive response if the fieldbus communication is lost.<br>0 = NOT SEL – No response.<br>1 = FAULT – Displays a fault (28, SERIAL 1 ERR) and the drive coasts to stop.<br>2 = CONST SP7 – Displays a warning (2005, IO COMM) and sets speed using 1208 CONST SPEED 7. This "alarm speed" remains active until the fieldbus writes a new reference value.<br>3 = LAST SPEED – Displays a warning (2005, IO COMM) and sets speed using the last operating level. This value is the average speed over the last 10 seconds. This "alarm speed" remains active until the fieldbus writes a new reference value.<br>**Caution:** If you select const speed 7, or last speed, make sure that continued operation is safe when fieldbus communication is lost. | | | | |
| 3019 | **COMM FAULT TIME** | **0.0…60.0 s** | **0.1 s** | **10.0 s** | |
| | Sets the communication fault time used with 3018 COMM FAULT FUNC.<br>• Brief interruptions in the fieldbus communication are not treated as faults if they are less than the COMM FAULT TIME value. | | | | |
| 3021 | **AI1 FAULT LIMIT** | **0.0…100.0%** | **0.1%** | **0.0%** | |
| | Sets a fault level for analog input 1. See 3001 AI<MIN FUNCTION. | | | | |
| 3022 | **AI2 FAULT LIMIT** | **0.0…100.0%** | **0.1%** | **0.0%** | |
| | Sets a fault level for analog input 2. See 3001 AI<MIN FUNCTION. | | | | |

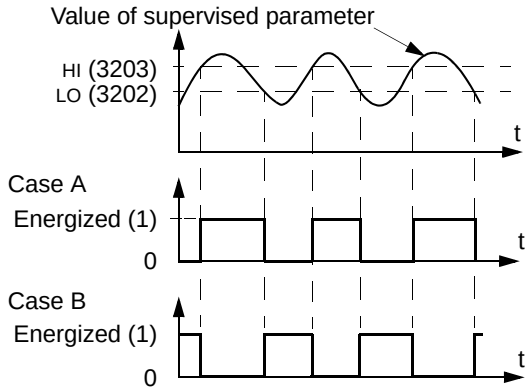
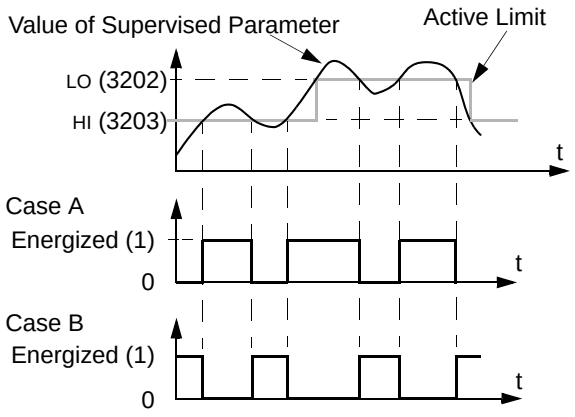
## Group 31: Automatic Reset

This group defines conditions for automatic resets. An automatic reset occurs after a particular fault is detected. The drive holds for a set delay time, then automatically restarts. You can limit the number of resets in a specified time period, and you can set up automatic resets for a variety of faults.

| Group 31: Automatic Reset | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3101 | **NR OF TRIALS** | **0…5** | **1** | **5** | |
| | Sets the number of allowed automatic resets within a trial period defined by 3102 TRIAL TIME.<br>• If the number of automatic resets exceeds this limit (within the trial time), the drive prevents additional automatic resets and remains stopped.<br>• Starting then requires a successful reset performed from the control panel or from a source selected by 1604 FAULT RESET SEL.<br>**Example:** Three faults have occurred in the trial time. The last is reset only if the value for 3101 NR OF TRIALS is 3 or more.<br>  <br>x = Automatic reset | | | | |
| 3102 | **TRIAL TIME** | **1.0…600.0 s** | **0.1 s** | **30.0 s** | |
| | Sets the time period used for counting and limiting the number of resets.<br>• See 3101 NR OF TRIALS. | | | | |
| 3103 | **DELAY TIME** | **0.0…120.0 s** | **0.1 s** | **6.0 s** | |
| | Sets the delay time between a fault detection and attempted drive restart.<br>• If DELAY TIME = zero, the drive resets immediately. | | | | |
| 3104 | **AR OVERCURRENT** | **0, 1** | **1** | **0** | |
| | Sets the automatic reset for the overcurrent function on or off.<br>0 = DISABLE – Disables automatic reset.<br>1 = ENABLE – Enables automatic reset.<br>• Automatically resets the fault (OVERCURRENT) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation. | | | | |
| 3105 | **AR OVERVOLTAGE** | **0, 1** | **1** | **1** | |
| | Sets the automatic reset for the overvoltage function on or off.<br>0 = DISABLE – Disables automatic reset.<br>1 = ENABLE – Enables automatic reset.<br>• Automatically resets the fault (DC OVERVOLT) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation. | | | | |
| 3106 | **AR UNDERVOLTAGE** | **0, 1** | **1** | **1** | |
| | Sets the automatic reset for the undervoltage function on or off.<br>0 = DISABLE – Disables automatic reset.<br>1 = ENABLE – Enables automatic reset.<br>• Automatically resets the fault (DC UNDERVOLTAGE) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation. | | | | |
| 3107 | **AR AI<MIN** | **0, 1** | **1** | **1** | |
| | Sets the automatic reset for the analog input less than minimum value function on or off.<br>0 = DISABLE – Disables automatic reset.<br>1 = ENABLE – Enables automatic reset.<br>• Automatically resets the fault (AI<MIN) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation.<br>**Warning! When the analog input signal is restored, the drive may restart, even after a long stop. Make sure that automatic, long delayed starts will not cause physical injury and/or damage equipment.** | | | | |
| 3108 | **AR EXTERNAL FLT** | **0, 1** | **1** | **1** | |
| | Sets the automatic reset for external faults function on or off.<br>0 = DISABLE – Disables automatic reset.<br>1 = ENABLE – Enables automatic reset.<br>• Automatically resets the fault (EXTERNAL FAULT 1 or EXTERNAL FAULT 2) after the delay set by 3103 DELAY TIME, and the drive resumes normal operation. | | | | |

## Group 32: Supervision

This group defines supervision for up to three signals from Group 01, Operating Data. Supervision monitors a specified parameter and energizes a relay output if the parameter passes a defined limit. Use Group 14, Relay Outputs, to define the relay and whether the relay activates when the signal is too low or too high.

| Group 32: Supervision | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3201 | **SUPERV 1 PARAM** | **101…199** | **1** | **103** | |
| | Selects the first supervised parameter.<br>• Must be a parameter number from Group 01 Operating Data.<br>• If the supervised parameter passes a limit, a relay output is energized.<br>• The supervision limits are defined in this group.<br>• The relay outputs are defined in Group 14 Relay Outputs (definition also specifies which supervision limit is monitored).<br>**LO ≤ HI**<br>Operating data supervision using relay outputs, when LO≤HI.<br>• Case A = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 OVER or SUPRV 2 OVER. Use for monitoring when/if the supervised signal exceeds a given limit. The relay remains active until the supervised value drops below the low limit.<br>• Case B = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV 1 UNDER or SUPRV 2 UNDER. Use for monitoring when/if the supervised signal falls below a given limit. The relay remains active until the supervised value rises above the high limit.<br>**Note!** Case LO ≤ HI represents a normal hysteresis.<br>  <br><br>**LO > HI**<br>Operating data supervision using relay outputs, when LO>HI.<br>The lowest limit (HI 3203) is active initially, and remains active until the supervised parameter goes above the highest limit (LO 3202), making that limit the active limit. That limit remains active until the supervised parameter goes below the lowest limit (HI 3203), making that limit active.<br>• Case A = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 OVER or SUPRV2 OVER. Initially the relay is de-energized. It is energized whenever the supervised parameter goes above the active limit.<br>• Case B = Parameter 1401 RELAY OUTPUT 1 (or 1402 RELAY OUTPUT 2, etc.) value is SUPRV1 UNDER or SUPRV2 UNDER. Initially the relay is energized. It is de-energized whenever the supervised parameter goes below the active limit.<br>  <br><br>**Note!** Case LO>HI represents a special hysteresis with two separate supervision limits. | | | | |
| 3202 | **SUPERV 1 LIM LO** | **Depends on selection** | - | 60.0 Hz | |
| | Sets the low limit for the first supervised parameter. See 3201 SUPERV 1 PARAM above. | | | | |
| 3203 | **SUPERV 1 LIM HI** | **Depends on selection** | - | 60.0 Hz | |
| | Sets the high limit for the first supervised parameter. See 3201 SUPERV 1 PARAM above. | | | | |
| 3204 | **SUPERV 2 PARAM** | **101…199** | **1** | **104** | |
| | Selects the second supervised parameter. See 3201 SUPERV 1 PARAM above. | | | | |

| Group 32: Supervision | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3205 | **SUPERV 2 LIM LO** | **Depends on selection** | | **4.6 A** | |
| | Sets the low limit for the second supervised parameter. See 3204 SUPERV 2 PARAM above. | | | | |
| 3206 | **SUPERV 2 LIM HI** | **Depends on selection** | | **4.6 A** | |
| | Sets the high limit for the second supervised parameter. See 3204 SUPERV 2 PARAM above. | | | | |
| 3207 | **SUPERV 3 PARAM** | **101…199** | **1** | **105** | |
| | Selects the third supervised parameter. See 3201 SUPERV 1 PARAM above. | | | | |
| 3208 | **SUPERV 3 LIM LO** | **Depends on selection** | | **100.0%** | |
| | Sets the low limit for the third supervised parameter. See 3207 SUPERV 3 PARAM above. | | | | |
| 3209 | **SUPERV 3 LIM HI** | **Depends on selection** | | **100.0%** | |
| | Sets the high limit for the third supervised parameter. See 3207 SUPERV 3 PARAM above. | | | | |

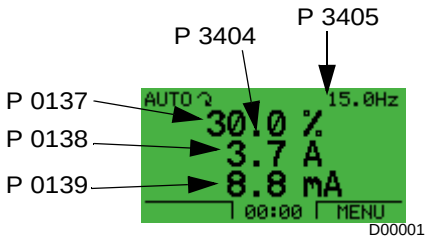
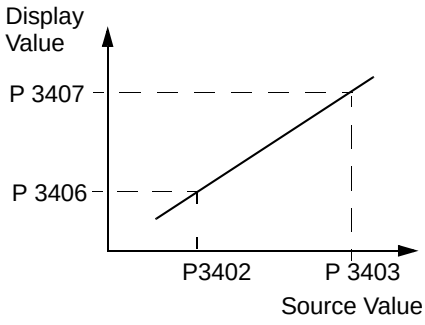
### Group 33: Information

This group provides access to information about the drive's current programs: versions and test date.

| Group 33: Information | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3301 | **FW VERSION** | **0000…FFFF hex** | **1** | **Firmware ver.** | |
| | Contains the version of the drive's firmware. | | | | |
| 3302 | **LP VERSION** | **0000…FFFF hex** | **1** | **0** | |
| | Contains the version of the loading package. | | | | |
| 3303 | **TEST DATE** | **yy.ww** | **1** | **0** | |
| | Contains the test date (yy.ww). | | | | |
| 3304 | **DRIVE RATING** | **-** | **-** | **-** | |
| | Indicates the drive's current and voltage rating. The format is XXXY, where:<br>• XXX =The nominal current rating of the drive in amps. If present, an "A" indicates a decimal point in the rating for the current. For example XXX = 8A8 indicates a nominal current rating of 8.8 Amps.<br>• Y = The voltage rating of the drive, where Y = 2 indicates a 208…240 Volt rating, and Y = 4 indicates a 380…480 Volt rating. | | | | |

## Group 34: Panel Display Process Variables

This group defines the content for control panel display (middle area), when the control panel is in the control mode.

| Group 34: Panel Display Process Variables | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3401 | **SIGNAL1 PARAM**<br>Selects the first parameter (by number) displayed on the control panel.<br>• Definitions in this group define display content when the control panel is in the control mode.<br>• Any Group 01 parameter number can be selected.<br>• Using the following parameters, the display value can be scaled, converted to convenient units, and/or displayed as a bar graph.<br>• The figure identifies selections made by parameters in this group.<br>100 = not selected – First parameter not displayed.<br>101…199 = Displays parameter 0101…0199. If parameter does not exist, the display shows "n.a.". | **100…199** | **1** | **103**<br>  | |
| 3402 | **SIGNAL1 MIN**<br>Defines the minimum expected value for the first display parameter.<br>Use parameters 3402, 3403, 3406, and 3407, for example to convert a Group 01 parameter, such as 0102 SPEED (in rpm) to the speed of a conveyor driven by the motor (in ft/min). For such a conversion, the source values in the figure are the min. and max. motor speed, and the display values are the corresponding min. and max. conveyor speed. Use parameter 3405 to select the proper units for the display.<br>Note! Selecting units does not convert values. | **Depends on selection** | - | **0.0 Hz**<br>  | |
| 3403 | **SIGNAL1 MAX**<br>Defines the maximum expected value for the first display parameter. | **Depends on selection** | - | **600.0 Hz** | |
| 3404 | **OUTPUT1 DSP FORM**<br>Defines the decimal point location for the first display parameter.<br>1…7 – Defines the decimal point location.<br>• Enter the number of digits desired to the right of the decimal point.<br>• See table for example using pi (3.14159).<br>8 = BAR METER – Specifies a bar meter display. | **0…8** | **1** | **5** | |

| 3404 Value | Display | Range |
|---|---|---|
| 0 | ± 3 | -32768…+32767 (Signed) |
| 1 | ± 3.1 | |
| 2 | ± 3.14 | |
| 3 | ± 3.142 | |
| 4 | 3 | 0…65535 (Unsigned) |
| 5 | 3.1 | |
| 6 | 3.14 | |
| 7 | 3.142 | |

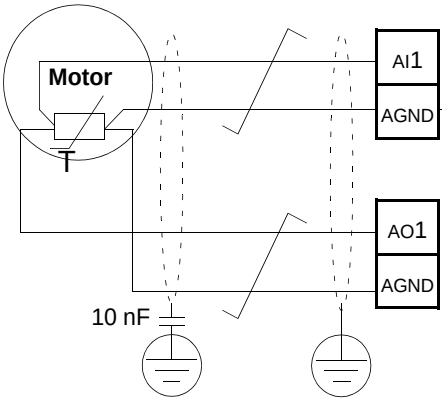
| Group 34: Panel Display Process Variables | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3405 | **OUTPUT1 DSP UNIT**<br>Selects the units used with the first display parameter.<br>• Enter positive values in parameter 3405 for a numeric display.<br>• Enter negative values in parameter 3405 for a bar-graph display.<br>0 = NOT SEL, 8 = kh, 16 = °F, 24 = GPM, 32 = kHz, 40 = $m^3/m$, 48 = gal/m, 56 = FPS<br>1 = A, 9 = °C, 17 = hp, 25 = PSI, 33 = Ohm, 41 = kg/s, 49 = gal/h, 57 = ft/s<br>2 = V, 10 = lb ft, 18 = MWh, 26 = CFM, 34 = ppm, 42 = kg/m, 50 = $ft^3/s$, 58 = $inH_2O$<br>3 = Hz, 11 = mA, 19 = m/s, 27 = ft, 35 = pps, 43 = kg/h, 51 = $ft^3/m$, 59 = in wg<br>4 = %, 12 = mV, 20 = $m^3/h$, 28 = MGD, 36 = l/s, 44 = mbar, 52 = $ft^3/h$, 60 = ft wg<br>5 = s, 13 = kW, 21 = $dm^3/s$, 29 = inHg, 37 = l/min, 45 = Pa, 53 = lb/s, 61 = lbsi<br>6 = h, 14 = W, 22 = bar, 30 = FPM, 38 = l/h, 46 = GPS, 54 = lb/m, 62 = ms<br>7 = rpm, 15 = kWh, 23 = kPa, 31 = kb/s, 39 = $m^3/s$, 47 = gal/s, 55 = lb/h, 63 = Mrev<br>117 = %ref, 119 = %dev, 121 = % SP, 123 = Iout, 125 = Fout, 127 = Vdc<br>118 = %act, 120 = % LD, 122 = %FBK, 124 = Vout, 126 = Tout | **-128…127** | **1** | **4** | |
| 3406 | **OUTPUT1 MIN**<br>Sets the minimum value displayed for the first display parameter. | **Depends on selection** | - | **0.0%** | |
| 3407 | **OUTPUT1 MAX**<br>Sets the maximum value displayed for the first display parameter. | **Depends on selection** | - | **1000.0%** | |
| 3408 | **SIGNAL 2 PARAM**<br>Selects the second parameter (by number) displayed on the control panel. See parameter 3401. | **100…199** | **1** | **104** | |
| 3409 | **SIGNAL 2 MIN**<br>Defines the minimum expected value for the second display parameter. See parameter 3402. | **Depends on selection** | - | **4.3 A** | |
| 3410 | **SIGNAL 2 MAX**<br>Defines the maximum expected value for the second display parameter. See parameter 3403. | **Depends on selection** | - | **9.2 A** | |
| 3411 | **OUTPUT 2 DSP FORM**<br>Defines the decimal point location for the second display parameter. See parameter 3404. | **0…8** | **1** | **5** | |
| 3412 | **OUTPUT 2 DSP UNIT**<br>Selects the units used with the second display parameter. See parameter 3405. | **-128…127** | **1** | **1** | |
| 3413 | **OUTPUT 2 MIN**<br>Sets the minimum value displayed for the second display parameter. See parameter 3406. | **Depends on selection** | - | **0.0 A** | |
| 3414 | **OUTPUT 2 MAX**<br>Sets the maximum value displayed for the second display parameter. See parameter 3407. | **Depends on selection** | - | **9.2 A** | |
| 3415 | **SIGNAL 3 PARAM**<br>Selects the third parameter (by number) displayed on the control panel. See parameter 3401. | **100…199** | **1** | **120** | |
| 3416 | **SIGNAL 3 MIN**<br>Defines the minimum expected value for the third display parameter. See parameter 3402. | **Depends on selection** | | **0.0%** | |
| 3417 | **SIGNAL 3 MAX**<br>Defines the maximum expected value for the third display parameter. See parameter 3403. | **Depends on selection** | | **100.0%** | |
| 3418 | **OUTPUT 3 DSP FORM**<br>Defines the decimal point location for the third display parameter. See parameter 3404. | **0…8** | **1** | **5** | |
| 3419 | **OUTPUT 3 DSP UNIT**<br>Selects the units used with the third display parameter. See parameter 3405. | **-128…127** | **1** | **11** | |
| 3420 | **OUTPUT 3 MIN**<br>Sets the minimum value displayed for the third display parameter. See parameter 3406. | **Depends on selection** | | **0.0 mA** | |

| Group 34: Panel Display Process Variables | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3421 | **OUTPUT 3 MAX** | **Depends on selection** | | **20.0 mA** | |
| | Sets the maximum value displayed for the third display parameter. See parameter 3407. | | | | |

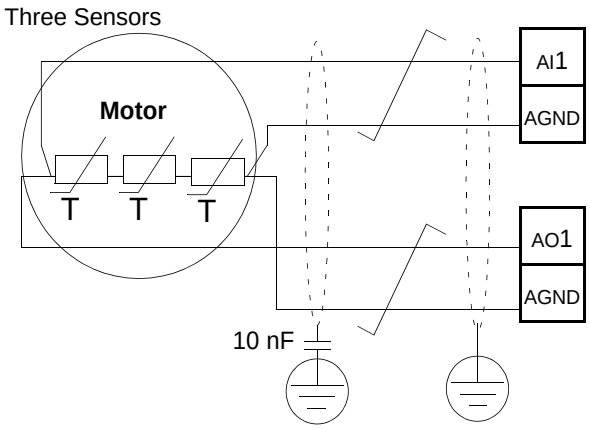
### Group 35: Motor Temp Meas

This group defines the detection and reporting for a particular potential fault – motor overheating, as detected by a temperature sensor. Typical connections are defined below.

One Sensor




Three Sensors

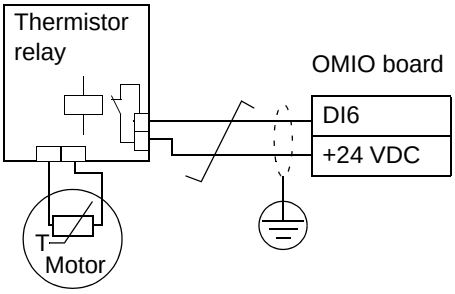


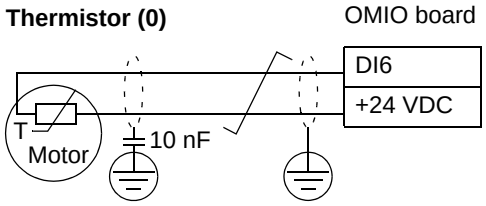

**Warning! IEC 60664 requires double or reinforced insulation between live parts and the surface of accessible parts of electrical equipment which are either non-conductive or conductive but not connected to the protective earth.**

To fulfil the insulation requirement, connect a thermistor (and other similar components) to the drive's control terminals using any of these alternatives:

- Separate the thermistor from live parts of the motor with double reinforced insulation.
- Protect all circuits connected to the drive's digital and analog inputs. Protect against contact, and insulate from other low voltage circuits with basic insulation (rated for the same voltage level as the drive's main circuit).
- Use an external thermistor relay. The relay insulation must be rated for the same voltage level as the drive's main circuit.

The figure below shows alternate thermistor connections. At the motor end the cable shield should be earthed through a 10 nF capacitor. If this is not possible, leave the shield unconnected.




For other faults, or for anticipating motor overheating using a model, see Group 30: Fault Functions.

**Group 35: Motor Temp Meas**

| Code | Description | Range | Resolution | Default | S |
|---|---|---|---|---|---|
| 3501 | **SENSOR TYPE** | **0…6** | **1** | **0** | |

Identifies the type of motor temperature sensor used, PT100 (°C) or PTC (ohms).

See parameters 1501 and 1507.

0 = NONE

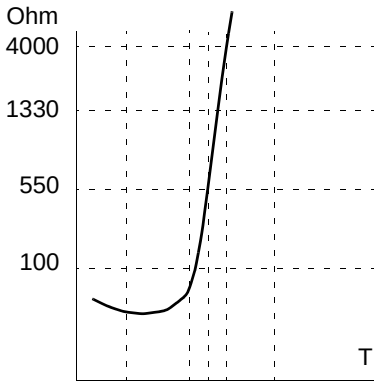
1 = 1 x PT100 – Sensor configuration uses one PT 100 sensor.
- Analog output AO1 or AO2 feeds constant current through the sensor.
- The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor.
- The temperature measurement function reads the voltage through analog input AI1 or AI2 and converts it to degrees centigrade.

2 = 2 x PT100 – Sensor configuration uses two PT 100 sensors.
- Operation is the same as for above 1 x PT100.

3 = 3 x PT100 – Sensor configuration uses three PT 100 sensors.
- Operation is the same as for above 1 x PT100.

4 = PTC – Sensor configuration uses one PTC.
- The analog output feeds a constant current through the sensor.
- The resistance of the sensor increases sharply as the motor temperature rises over the PTC reference temperature ($T_{ref}$), as does the voltage over the resistor. The temperature measurement function reads the voltage through analog input AI1 and converts it into ohms.
- The figure shows typical PTC sensor resistance values as a function of the motor operating temperature.

| Temperature | Resistance |
|---|---|
| Normal | 0 … 1.5 kohm |
| Excessive | ≥ 4 kohm |



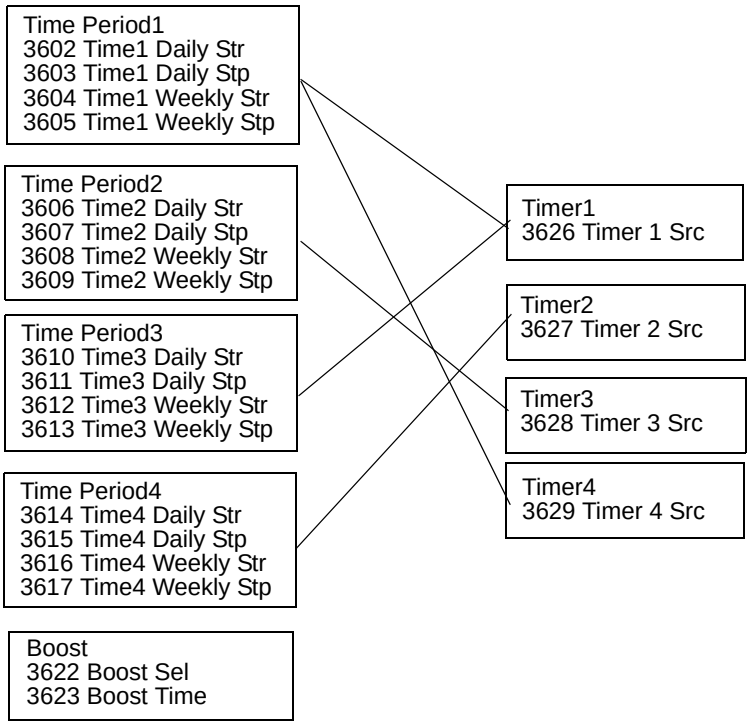
| Group 35: Motor Temp Meas | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| | 5 = THERMISTOR (0) – Sensor configuration uses a thermistor.<br>• Motor thermal protection is activated through a digital input. Connect either a PTC sensor or a normally closed thermistor relay to a digital input. The drive reads the digital input states as shown in the above table.<br>• When the digital input is '0' the motor is overheated.<br>• See the figures in the introduction to this Group.<br>6 = THERMISTOR (1) – Sensor configuration uses a thermistor.<br>• Motor thermal protection is activated through a digital input. Connect a normally open thermistor relay to a digital input. The drive reads the digital input states as shown in the above table.<br>• When the digital input is '1' the motor is overheated.<br>See the figures in the introduction to this Group. | | | | |
| 3502 | **INPUT SELECTION** | **1…8** | **1** | **1** | |
| | Defines the input used for the temperature sensor.<br>1 = AI1 – PT100 and PTC.<br>2 = AI2 – PT100 and PTC.<br>3…8 = DI1…DI6 – Thermistor | | | | |
| 3503 | **ALARM LIMIT** | **-10...200 °C / 0...5000 Ohm / 0…1** | **1** | **110 °C / 1500 Ohm / 0** | |
| | Defines the alarm limit for motor temperature measurement.<br>• At motor temperatures above this limit, the drive displays an alarm (2010, MOTOR OVERTEMP)<br>For thermistors:<br>0 = de-activated<br>1 = activated | | | | |
| 3504 | **FAULT LIMIT** | **-10...200 °C / 0...5000 Ohm / 0…1** | **1** | **130 °C / 4000 Ohm / 0** | |
| | Defines the fault limit for motor temperature measurement.<br>• At motor temperatures above this limit, the drive displays a fault (9, MOTOR OVERTEMP) and stops the drive.<br>For thermistors:<br>0 = de-activated<br>1 = activated | | | | |

### Group 36: Timer Functions

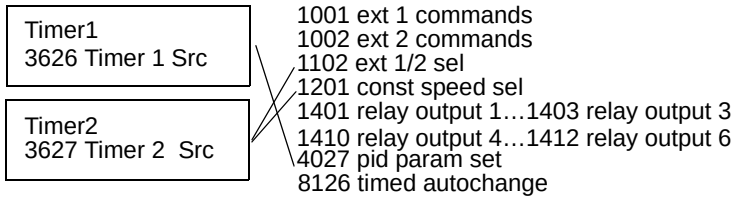
This group defines the timer functions. The timer functions include:

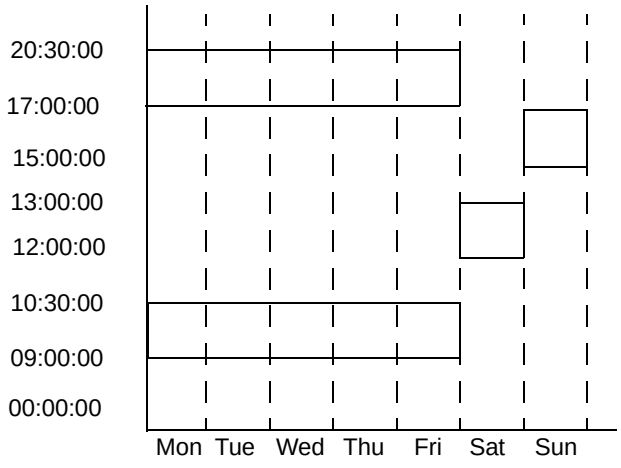
- Four daily start and stop times.
- Four weekly start, stop and boost times.
- Four timers for collecting selected periods together.

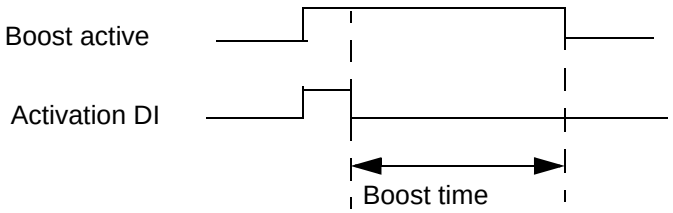
A timer can be connected to multiple time periods and a time period can be in multiple timers.




A parameter can be connected to only one time.



| Group 36: Timer Functions | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3601 | **TIMERS ENABLE**<br>Selects the source for the timer enable signal.<br>0 = NOT SEL – Timed functions are disabled.<br>1 = DI1- Defines digital input DI1 as the timed function enable signal.<br>• The digital input must be activated for timed functions enable.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the timed function enable signal.<br>7 = ENABLED – Timed functions are enabled.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as the timed function enable signal.<br>• This digital input must be de-activated for timed function enable.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the timed function enable signal. | **-6…7** | **1** | **0** | |
| 3602 | **START TIME 1**<br>Defines the daily start time.<br>• The time can be changed in steps of 2 seconds.<br>• If parameter value is 07:00:00, then the period will be activated at 7 a.m.<br>• The figure shows multiple periods on different weekdays.<br>When editing parameters to set times:<br>• Use arrow keys to select desired hour setting.<br>• Press NEXT to advance to minutes.<br>• Use arrow keys to select desired minutes setting.<br>• Press NEXT to advance to minutes.<br>• Use arrow keys to select desired seconds setting.<br>• Press SAVE.<br>  <br> | **00:00:00…23:59:58** | **2 s** | **12:00:00** | |
| 3603 | **STOP TIME 1**<br>Defines the daily stop time.<br>• The time can be changed in steps of 2 seconds.<br>• If the parameter value is 09:00:00, then the period will be deactivated at 9 a.m. | **00:00:00…23:59:58** | **2 s** | **12:00:00** | |
| 3604 | **START DAY 1**<br>Defines the weekly start day.<br>1 = Monday…7 = Sunday.<br>• If parameter value is 1, then period 1 weekly is active from Monday midnight (00:00:00). | **1…7** | **1** | **1** | |
| 3605 | **STOP DAY 1**<br>Defines weekly stop day.<br>1 = Monday…7 = Sunday.<br>• If parameter value is 5, then timer 1 weekly will be deactivated on Friday midnight (23:59:58). | **1…7** | **1** | **1** | |
| 3606 | **START TIME 2**<br>Defines timer2 daily start time.<br>• See parameter 3602 | **00:00:00…23:59:58** | **2 s** | **12:00:00** | |
| 3607 | **STOP TIME 2**<br>Defines timer2 daily stop time.<br>• See parameter 3603 | **00:00:00…23:59:58** | **2 s** | **12:00:00** | |
| 3608 | **START DAY 2**<br>Defines timer 2 weekly start day.<br>• See parameter 3604 | **1…7** | **1** | **1** | |

| Group 36: Timer Functions | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3609 | **STOP DAY 2**<br>Defines timer 2 weekly stop day.<br>• See parameter 3605 | **1…7** | **1** | **1** | |
| 3610 | **START TIME 3**<br>Defines timer 3 daily start time.<br>• See parameter 3602 | **00:00:00…23:59:58** | **2 s** | **12:00:00** | |
| 3611 | **STOP TIME 3**<br>Defines timer 3 daily stop time.<br>• See parameter 3603 | **00:00:00…23:59:58** | **2 s** | **12:00:00** | |
| 3612 | **START DAY 3**<br>Defines timer 3 weekly start day.<br>• See parameter 3604 | **1…7** | **1** | **1** | |
| 3613 | **STOP DAY 3**<br>Defines timer 3 weekly stop day.<br>• See parameter 3605 | **1…7** | **1** | **1** | |
| 3614 | **START TIME 4**<br>Defines timer 4 daily start time.<br>• See parameter 3602 | **00:00:00…23:59:58** | **2 s** | **12:00:00** | |
| 3615 | **STOP TIME 4**<br>Defines timer 4 daily start time.<br>• See parameter 3603 | **00:00:00…23:59:58** | **2 s** | **12:00:00** | |
| 3616 | **START DAY 4**<br>Defines timer 4 weekly start day.<br>• See parameter 3604 | **1…7** | **1** | **1** | |
| 3617 | **STOP DAY 4**<br>Defines timer 4 weekly stop day.<br>• See parameter 3605 | **1…7** | **1** | **1** | |
| 3622 | **BOOST SEL**<br>Selects the source for the boost signal.<br>0 = NOT SEL- Boost signal is disabled.<br>1 = DI1-Defines DI1 as the boost signal.<br>2…6 = DI2…DI6 – Defines DI2…DI6 as the boost signal.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as the boost signal.<br>-2…-6 = Defines an inverted digital input DI2…DI6 as the boost signal. | **-6…6** | **1** | **0** | |
| 3623 | **BOOST TIME**<br>Defines the boost ON time. Time is started when boost sel signal is released. If parameter range is 01:30:00, then boost is active for 1 hour and 30 minutes after activation DI is released.<br>  | **00:00:00-23:59:58** | **2 s** | **00:00:00** | |

| Group 36: Timer Functions | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 3626 | **TIMER 1 SRC**<br>Collects all wanted timers to a timer function.<br>0 = NOT SEL- No timers have been selected.<br>1 = P1- Time Period 1 selected in the timer.<br>2 = P2- Time Period 2 selected in the timer.<br>3 = P2 + P1 – Time Periods 1 and 2 selected in the timer.<br>4 = P3 – Time Period 3 selected in the timer.<br>5 = P3 + P1 – Time Periods 1 and 3 selected in the timer.<br>6 = P3 + P2 – Time Periods 2 and 3 selected in the timer.<br>7 = P3 + P2 + P1- Time Periods 1, 2 and 3 selected in the timer.<br>8 = P4 – Time Period 4 selected in the timer.<br>9 = P4+ P1- Time Periods 4 and 1 selected in the timer.<br>10 = P4 + P2 – Time Periods 4 and 2 selected in the timer.<br>11 = P4 + P2 + P1- Time Periods 4,2 and 1 selected in the timer.<br>12 = P4 + P3 – Time Periods 4 and 3 selected in the timer.<br>13 = P4 + P3 + P1- Time Periods 4,3 and 1 selected in the timer.<br>14 = P4 + P3 + P2 – Time Periods 4,3 and 2 selected in the timer.<br>15 = P4 + P3 + P2 + P1- Time Periods 4,3,2 and 1 selected in the timer.<br>16 = BOOST (B)- Boost selected in the timer.<br>17 = B + P1 – Boost and Time Period 1 selected in the timer.<br>18 = B+ P2- Boost and Time Period 2 selected in the timer.<br>19 = B + P2 + P1 – Boost and Time Periods 1 and 2 selected in the timer.<br>20 = B + P3- Boost and Time Period 3 selected in the timer function.<br>21 = B + P3 + P1- Boost and Time Period 3 and 1 selected in the timer.<br>22 = B + P3 + P2 – Boost and Time Periods 3 and 2 selected in the timer.<br>23 = B + P3 + P2 + P1 – Boost and Time Periods 3,2 and 1 selected in the timer.<br>24 = B + P4 – Boost and Time Periods 4 selected in the timer.<br>25 = B + P4 + P1- Boost and Time Period 4 and Timer 1 selected in the timer.<br>26 = B + P4 + P2 – Boost and Time Period 4 and 2 selected in the timer.<br>27 = B + P4 + P2 + P1 – Boost and Time Periods 4,2 and 1 selected in the timer.<br>28 = B + P4 + P3 – Boost and Time Periods 4, 3<br>29 = B + P4 + P3 +P1 – Boost and Time Periods 4, 3 and 1 selected in the timer.<br>30 = B + P4 + P3 + P2- Boost and Time Periods 4, 3 and 2 selected.<br>31 = B+ P4 + P3 + P2 + P1- Boost and Time Periods 4, 3, 2 and 1 selected. | **0…31** | **1** | **0** | |
| 3627 | **TIMER 2 SRC**<br>• See parameter 3626. | **0…31** | **1** | **0** | |
| 3628 | **TIMER 3 SRC**<br>• See parameter 3626. | **0…31** | **1** | **0** | |
| 3629 | **TIMER 4 SRC**<br>• See parameter 3626. | **0…31** | **1** | **0** | |

## Group 40: Process PID Set 1

This group defines a set of parameters used with the Process PID (PID1) controller.

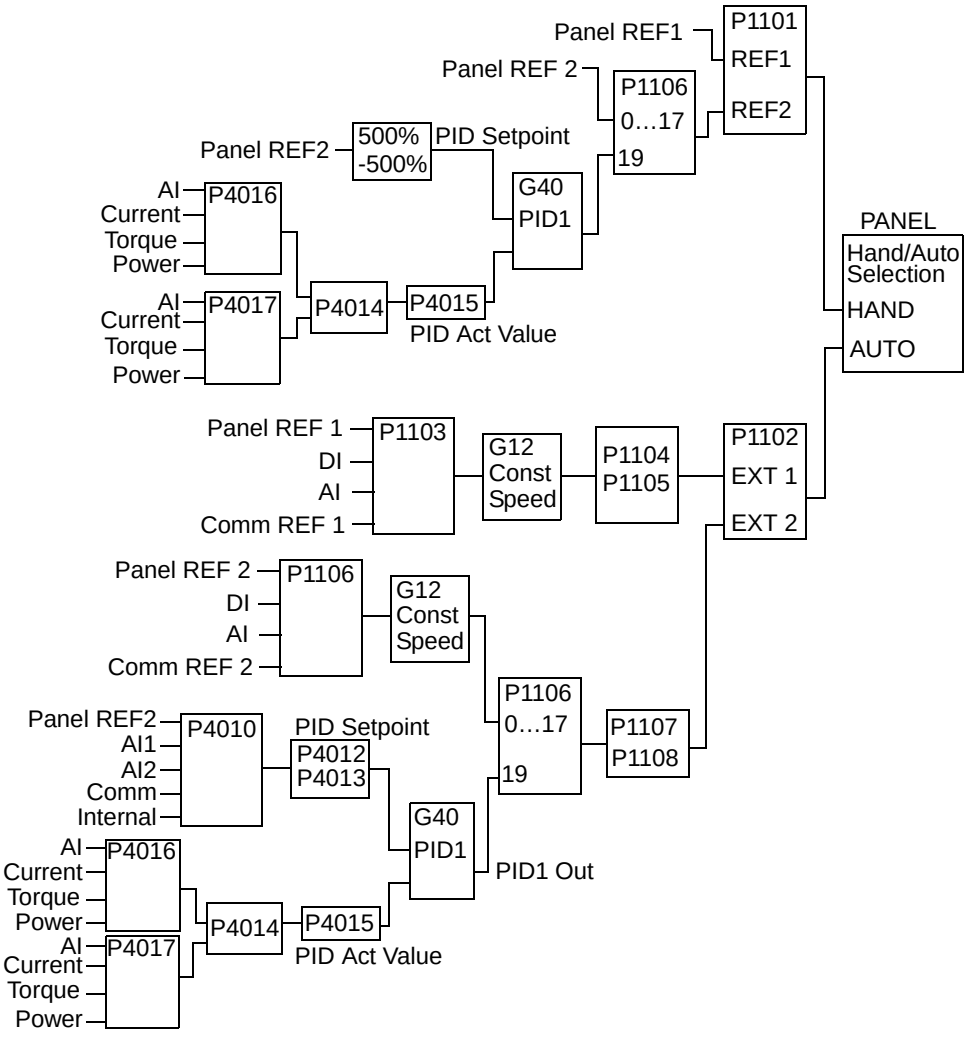
Typically only parameters in this group are needed.

*PID Controller – Basic Set-up*

In PID control mode, the drive compares a reference signal (setpoint) to an actual signal (feedback), and automatically adjusts the speed of the drive to match the two signals. The difference between the two signals is the error value.

Typically PID control mode is used, when the speed of a fan or pump needs to be controlled based on pressure, flow or temperature. In most cases – when there is only 1 transducer signal wired to the ACH550 – only parameter group 40 is needed.

A Schematic of setpoint/feedback signal flow using parameter group 40 is presented.




**Note!** In order to activate and use the PID controller Parameter 1106 must be set to value 19.

*PID Controller – Advanced*

ACH550 has 2 separate PID Controllers:

- Process PID (PID1) and
- External PID (PID2)

Process PID (PID1) has 2 separate sets of parameters:

- Process PID (PID1) SET1, defined in Group 40 and
- Process PID (PID1) SET2, defined in Group 41

You can select between the 2 different sets by using parameter 4027.

Typically two different PID-Controller sets are used when the load of the motor changes considerably from one situation to another.

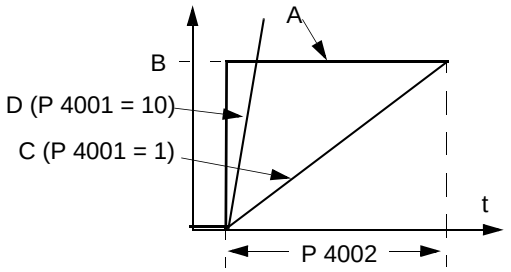
You can use External PID (PID2), defined in Group 42, in 2 different ways:

- Instead of using additional PID-controller hardware, you can set outputs of the ACH550 to control a field instrument like a damper or a valve. In this case, set Parameter 4230 to value 0. (0 is the default value.)
- You can use External PID (PID2) as an additional PID-controller to Process PID (PID1) to trim or fine-tune the speed of the ACH550.

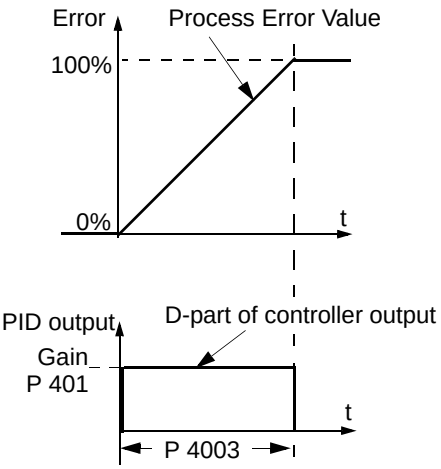
An example of the trimming is a return fan that follows the speed of the supply fan. As the return fan needs to run faster or slower then the supply fan in order to create under- or overpressure, correction factors to the supply fan speed are needed. Use External PID (PID2) in the return fan drive to provide these corrections.

| Group 40: Process PID Set 1 | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 4001 | **GAIN** | **0.1…100.0** | **0.1** | **2.5** | |
| | Defines the PID Controller's gain.<br>• The setting range is 0.1… 100.<br>• At 0.1, the PID Controller output changes one-tenth as much as the error value.<br>• At 100, the PID Controller output changes one hundred times as much as the error value.<br>Use the proportional gain and integration time values to adjust the responsiveness of the system.<br>• A low value for proportional gain and a high value for integral time ensures stable operation, but provides sluggish response.<br>If the proportional gain value is too large or the integral time too short, the system can become unstable.<br>**Procedure:**<br>• Initially, set:<br>  • 4001 GAIN = 0.0.<br>  • 4002 INTEGRATION TIME = 20 seconds.<br>• Start the system and see if it reaches the set point quickly while maintaining stable operation. If not, increase GAIN (4001) until the actual signal (or drive speed) oscillates constantly. It may be necessary to start and stop the drive to induce this oscillation.<br>• Reduce GAIN (4001) until the oscillation stops.<br>• Set GAIN (4001) to 0.4 to 0.6 times the above value.<br>• Decrease the INTEGRATION TIME (4002) until the feedback signal (or drive speed) oscillates constantly. It may be necessary to start and stop the drive to induce this oscillation.<br>• Increase INTEGRATION TIME (4002) until the oscillation stops.<br>• Set INTEGRATION TIME (4002) to 1.15 to 1.5 times the above value.<br>• If the feedback signal contains high frequency noise, increase the value of Parameter 1303 FILTER AI1 or 1306 FILTER AI2 until the noise is filtered from the signal. | | | | |

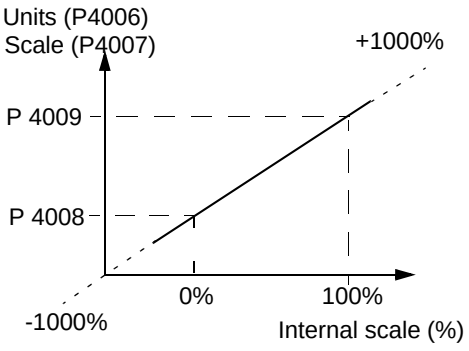
| Group 40: Process PID Set 1 | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 4002 | **INTEGRATION TIME** | **0.0…600.0 s** | **0.1 s** | **3.0 s** | |
| | Defines the PID Controller's integration time.<br>Integration time is, by definition, is the time required to increase the output by the error value:<br>• Error value is constant and 100%.<br>• Gain = 1.<br>• Integration time of 1 second denotes that a 100% change is achieved in 1 second.<br>0.0 = NOT SEL – Disables integration (I-part of controller).<br>0.1…600.0 = Integration time (seconds).<br>See 4001 for adjustment procedure. | | | | |
| 4003 | **DERIVATION TIME** | **0.0…10.0 s** | **0.1 s** | **0.0 s** | |
| | Defines the PID Controller's derivation time.<br>• You can add the derivative of the error to the PID controller output. The derivative is the error value's rate of change. For example, if the process error value changes linearly, the derivative is a constant added to the PID controller output.<br>• The error-derivative is filtered with a 1-pole filter. The time constant of the filter is defined by parameter 4004 PID DERIV FILTER.<br>0.0 = NOT SEL – Disables the error-derivative part of the PID controller output<br>0.1…10.0 = Derivation time (seconds) | | | | |
| 4004 | **PID DERIV FILTER** | **0.0…10.0 s** | **0.1 s** | **1.0 s** | |
| | Defines the filter time constant for the error-derivative part of the PID controller output.<br>• Before being added to the PID controller output, the error-derivative is filtered with a 1-pole filter.<br>• Increasing the filter time smooths the error-derivative, reducing noise.<br>0.0 = NOT SEL – Disables the error-derivative filter.<br>0.1…10.0 = Filter time constant (seconds). | | | | |
| 4005 | **ERROR VALUE INV** | **0, 1** | **-** | **0** | |
| | Selects either a normal or inverted relationship between the feedback signal and the drive speed.<br>0 = NO – Normal, a decrease in feedback signal increases drive speed. Error = Ref - Fbk<br>1 = YES – Inverted, a decrease in feedback signal decreases drive speed. Error = Fbk - Ref | | | | |
| 4006 | **UNIT** | **0…31** | **-** | **4** | |
| | Selects the unit for the PID controller actual values. (PID1 parameters 0128, 0130, and 0132).<br>• See parameter 3405 for list of available units. | | | | |
| 4007 | **DSP FORMAT** | **0…4** | **1** | **1** | |
| | Defines the decimal point location in PID controller actual values.<br>• Enter the decimal point location counting in from the right of the entry.<br>• See table for example using pi (3.14159). | | | | |

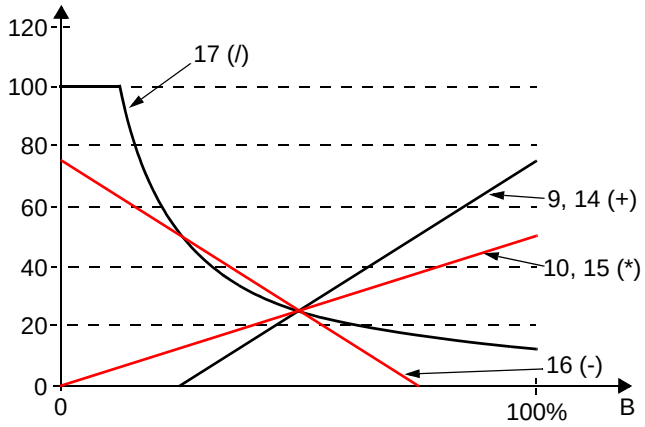


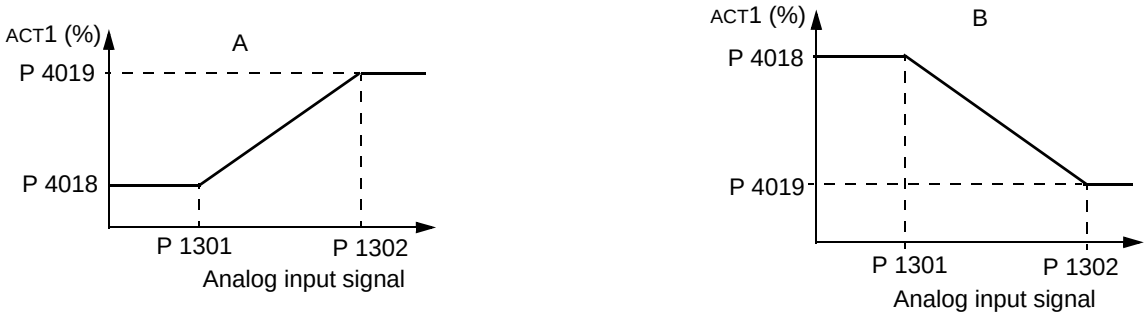

A = Error
B = Error value step
C = Controller output with Gain = 1
D = Controller output with Gain = 10

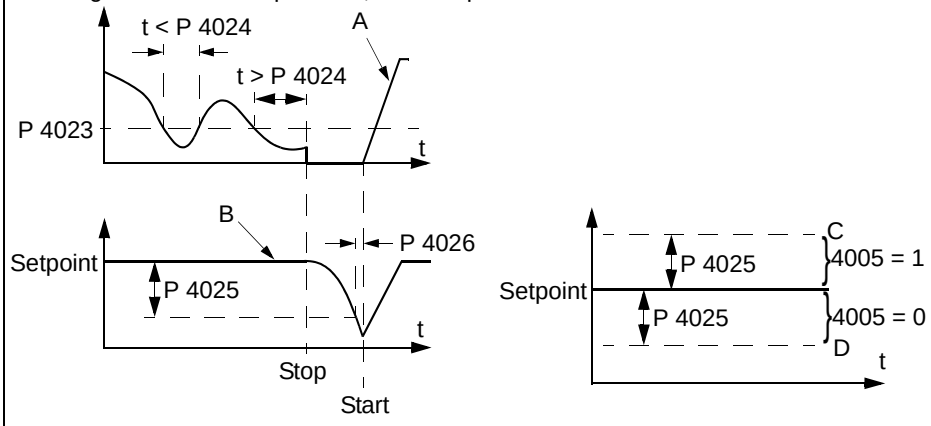



| 4007 Value | Entry | Display |
|---|---|---|
| 0 | 0003 | 3 |
| 1 | 0031 | 3.1 |
| 2 | 0314 | 3.14 |
| 3 | 3142 | 3.142 |

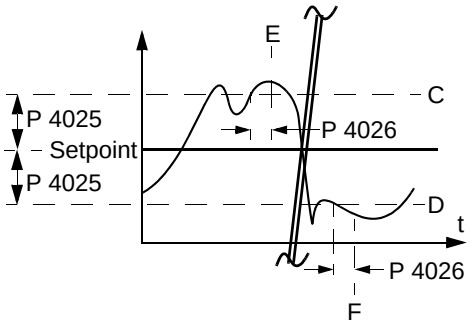
| Group 40: Process PID Set 1 | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 4008 | **0 % VALUE** | **-1000.0…1000.0%** | **0.1%** | **0.0%** | |
| | Defines (together with the next parameter) the scaling applied to the PID controller's actual values (PID1 parameters 0128, 0130, and 0132).<br>• Units and scale are defined by parameters 4006 and 4007.<br>  | | | | |
| 4009 | **100 % VALUE** | **-1000.0…1000.0%** | **0.1%** | **100.0%** | |
| | Defines (together with the previous parameter) the scaling applied to the PID controller's actual values.<br>• Units and scale are defined by parameters 4006 and 4007. | | | | |
| 4010 | **SET POINT SEL** | **0…19** | **1** | **1** | ✓ |
| | Defines the reference signal source for the PID controller.<br>• Parameter has no significance when the PID regulator is by-passed (see 8121 REG BYPASS CTRL).<br>0 = KEYPAD – Control panel provides reference.<br>1 = AI1 – Analog input 1 provides reference.<br>2 = AI2 – Analog input 2 provides reference.<br>8 = COMM – Fieldbus provides reference.<br>9 = COMM + AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below.<br>10 = COMM * AI1 – Defines a fieldbus and analog input 1 (AI1) combination as the reference source. See Analog Input Reference Correction below.<br>11 = DI3U, 4D(RNC) – Digital inputs, acting as a motor potentiometer control, provide reference.<br>• DI3 increases the speed (the U stands for "up")<br>• DI4 decreases the reference (the D stands for "down").<br>• Parameter 2205 ACCELER TIME 2 controls the reference signal's rate of change.<br>• R = Stop command resets the reference to zero.<br>• NC = Reference value is not copied.<br>12 = DI3U, 4D(NC) – Same as DI3U, 4D(RNC) above, except:<br>• Stop command does not reset reference to zero. At restart the motor ramps up, at the selected acceleration rate, to the stored reference.<br>13 = DI5U, 6D(NC) – Same as DI3U, 4D(NC) above, except:<br>• Uses digital inputs DI5 and DI6.<br>14 = AI1 + AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.<br>15 = AI1 * AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.<br>16 = AI1 - AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.<br>17 = AI1/AI2 – Defines an analog input 1 (AI1) and analog input 2 (AI2) combination as the reference source. See Analog Input Reference Correction below.<br>19 = INTERNAL – A constant value set using parameter 4011 provides reference. | | | | |

| Group 40: Process PID Set 1 | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| | **Analog Input Reference Correction**<br>Parameter values 9, 10, and 14…17 use the formula in the following table.<br>**Value Setting** / **AI reference is calculated as following:**<br>C + B: C value + (B value - 50% of reference value)<br>C * B: C value * (B value / 50% of reference value)<br>C - B: (C value + 50% of reference value) - B value<br>C / B: (C value * 50% of reference value) / B value<br>Where:<br>• C = Main Reference value ( = COMM for values 9, 10 and = AI1 for values 14…17).<br>• B = Correcting reference ( = AI1 for values 9, 10 and = AI2 for values 14…17).<br>Example:<br>The figure shows the reference source curves for value settings 9, 10, and 14…17, where:<br>• C = 25%.<br>• P 4012 SETPOINT MIN = 0.<br>• P 4013 SETPOINT MAX = 0.<br>• B varies along the horizontal axis.<br>  <br> | | | | |
| 4011 | **INTERNAL SETPNT**<br>Sets a constant value used for the process reference.<br>• Units and scale are defined by parameters 4006 and 4007. | **-1000.0…1000.0%** | **0.1%** | **40.0%** | |
| 4012 | **SETPOINT MIN**<br>Sets the minimum value for the reference signal source. See parameter 4010. | **-500.0%…500.0%** | **0.1%** | **0.0%** | |
| 4013 | **SETPOINT MAX**<br>Sets the maximum value for the reference signal source. See parameter 4010. | **-500.0%…500.0%** | **0.1%** | **100.0%** | |
| 4014 | **FBK SEL**<br>Defines the PID controller feedback (actual signal).<br>• You can define a combination of two actual values (ACT1 and ACT2) as the feedback signal.<br>• Use parameter 4016 to define the source for actual value 1 (ACT1).<br>• Use parameter 4017 to define the source for actual value 2 (ACT2).<br>1 = ACT1 – Actual value 1 (ACT1) provides the feedback signal.<br>2 = ACT1-ACT2 – ACT1 minus ACT2 provides the feedback signal.<br>3 = ACT1+ACT2 – ACT1 plus ACT2 provides the feedback signal.<br>4 = ACT1*ACT2 – ACT1 times ACT2 provides the feedback signal.<br>5 = ACT1/ACT2 – ACT1 divided by ACT2 provides the feedback signal.<br>6 = MIN (A1, A2) – The smaller of ACT1 or ACT2 provides the feedback signal.<br>7 = MAX (A1, A2) – The greater of ACT1 or ACT2 provides the feedback signal.<br>8 = SQRT (A1-A2) – Square root of the value for ACT1 minus ACT2 provides the feedback signal.<br>9 = SQA1 + SQA2 – Square root of ACT1 plus the square root of ACT2 provides the feedback signal.<br>10 = SQRT (ACT1) – Square root of ACT1 provides the feedback signal. | **1…10** | **1** | **1** | |

| Group 40: Process PID Set 1 | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 4015 | **FBK MULTIPLIER** | **-32.768…32.767** | **0.001** | **0.000** | |
| | Defines an extra multiplier for the PID FBK value defined by parameter 4014.<br>• Used mainly in applications where the flow is calculated from the pressure difference.<br>0 = NOT USED.<br>-32.768…32.767 = Multiplier applied to the signal defined by parameter 4014 FBK SEL.<br><br>**Example:** FBK = Multiplier $\times \sqrt{A1 - A2}$ | | | | |
| 4016 | **ACT1 INPUT** | **1…5** | **1** | **2** | ✓ |
| | Defines the source for actual value 1 (ACT1).<br>1 = AI 1 – Uses analog input 1 for ACT1.<br>2 = AI 2 – Uses analog input 2 for ACT1.<br>3 = Current – Uses current for ACT1, scaled so:<br>• Min ACT1 = 0 current<br>• Max ACT1 = 2 x nominal current<br>4 = Torque – Uses torque for ACT1, scaled so:<br>• Min ACT1 = -2 x nominal torque<br>• Max ACT1 = 2 x nominal torque<br>5 = Power – Uses power for ACT1, scaled so:<br>• Min ACT1 = -2 x nominal power<br>• Max ACT1 = 2 x nominal power | | | | |
| 4017 | **ACT2 INPUT** | **1…5** | **1** | **2** | ✓ |
| | Defines the source for actual value 2 (ACT2).<br>1 = AI 1 – Uses analog input 1 for ACT2.<br>2 = AI 2 – Uses analog input 2 for ACT2.<br>3 = Current – Uses current for ACT2, scaled so:<br>• Min ACT2 = 0 current<br>• Max ACT2 = 2 x nominal current<br>4 = Torque – Uses torque for ACT2, scaled so:<br>• Min ACT2 = -2 x nominal torque<br>• Max ACT2 = 2 x nominal torque<br>5 = Power – Uses power for ACT2, scaled so:<br>• Min ACT2 = -2 x nominal power<br>• Max ACT2 = 2 x nominal power | | | | |
| 4018 | **ACT1 MINIMUM** | **-1000…1000%** | **1%** | **0%** | |
| | Sets the minimum value for ACT1.<br>• Used with analog input min/max settings (e.g. 1301 MINIMUM AI1, 1302 MAXIMUM AI1).<br>• Scales analog inputs used as actual values.<br>• See figure: A= Normal; B = Inversion (ACT1 MINIMUM > ACT1 MAXIMUM)<br>  | | | | |
| 4019 | **ACT1 MAXIMUM** | **-1000…1000%** | **1%** | **100%** | |
| | Sets the maximum value for ACT1.<br>• See 4018 ACT1 MINIMUM. | | | | |
| 4020 | **ACT2 MINIMUM** | **-1000…1000%** | **1%** | **0%** | |
| | Sets the minimum value for ACT2.<br>• See 4018 ACT1 MINIMUM. | | | | |

| Group 40: Process PID Set 1 | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 4021 | **ACT2 MAXIMUM**<br>Sets the maximum value for ACT2.<br>• See 4018 ACT1 MINIMUM. | **-1000…1000%** | **1%** | **100%** | |
| 4022 | **SLEEP SELECTION**<br>Defines the control for the PID sleep function.<br>0 = NOT SEL– Disables the PID sleep control function.<br>1 = DI1 – Defines digital input DI1 as the control for the PID sleep function.<br>• Activating the digital input activates the sleep function.<br>• De-activating the digital input restores PID control.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for the PID sleep function.<br>• See DI1 above.<br>7 = INTERNAL – Defines the output rpm/frequency, process reference, and process actual value as the control for the PID sleep function. Refer to parameters 4025 WAKE-UP DEV and 4023 PID SLEEP LEVEL.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as the control for the PID sleep function.<br>• De-activating the digital input activates the sleep function.<br>• Activating the digital input restores PID control.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for the PID sleep function.<br>• See DI1(INV) above. | **-6…7** | **-** | **0** | |
| 4023 | **PID SLEEP LEVEL**<br>Sets the motor speed / frequency that enables the PID sleep function – a motor speed / frequency below this level, for at least the time period 4024 PID SLEEP DELAY enables the PID sleep function (stopping the drive).<br>• Requires 4022 = 7 INTERNAL.<br>• See figure: A = PID output level; B = PID process feedback.<br>  | **0.0…120.0 Hz / 0…7200 rpm** | **0.1 Hz / 1 rpm** | **0.0 Hz** | |
| 4024 | **PID SLEEP DELAY**<br>Sets the time delay for the PID sleep function – a motor speed / frequency below 4023 PID SLEEP LEVEL for at least this time period enables the PID sleep function (stopping the drive).<br>• See 4023 PID SLEEP LEVEL above. | **0.0…3600.0 s** | **0.1 s** | **60.0 s** | |

| Group 40: Process PID Set 1 | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 4025 | **WAKE-UP DEVIATION** | **0.0…1000%** | **0.1** | **0.0** | |
| | Defines the wake-up deviation – a deviation from the setpoint greater than this value, for at least the time period 4026 WAKE-UP DELAY, re-starts the PID controller.<br>• Parameters 4006 and 4007 define the units and scale.<br>• Parameter 4005 = 0,<br>Wake-up level = Setpoint – Wake-up deviation.<br>• Parameter 4005 = 1,<br>Wake-up level = Setpoint + Wake-up deviation.<br>• Wake-up level can be above or below setpoint.<br>See figures:<br>• C = Wake-up level when parameter 4005 = 1<br>• D = Wake-up level when parameter 4005 = 0<br>• E = Feedback is above wake-up level and lasts longer than 4026 WAKE-UP DELAY – PID function wakes up.<br>• F = Feedback is below wake-up level and lasts longer than 4026 WAKE-UP DELAY – PID function wakes up. | | | | |
| 4026 | **WAKE-UP DELAY** | **0.00…60.00 s** | **0.01 s** | **0.50 s** | |
| | Defines the wake-up delay –<br>a deviation from the setpoint greater than 4025 WAKE-UP DEVIATION, for at least this time period, re-starts the PID controller.<br>• See 4023 PID SLEEP LEVEL above. | | | | |
| 4027 | **PID 1 PARAM SET** | **-6…11** | **1** | **0** | |
| | Defines how selections are made between PID Set 1 and PID Set 2.<br>PID parameter set selection. When set 1 is selected, parameters 4001…4026 are used.<br>When set 2 is selected, parameters 4101…4126 are used.<br>0 = SET 1 – PID Set 1 (parameters 4001…4026) is active.<br>1 = DI1 – Defines digital input DI1 as the control for PID Set selection.<br>• Activating the digital input selects PID Set 2.<br>• De-activating the digital input selects PID Set 1.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for PID Set selection.<br>• See DI1 above.<br>7 = SET 2 – PID Set 2 (parameters 4101…4126) is active.<br>8…11 = TIMER 1…4 – Defines the Timer as the control for the PID Set selection (Timer de-activated = PID Set 1; Timer activated = PID Set 2)<br>See parameter Group 36: Timer Functions.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as the control for PID Set selection.<br>• Activating the digital input selects PID Set 1.<br>• De-activating the digital input selects PID Set 2.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines an inverted digital input DI2…DI6 as the control for PID Set selection.<br>• See DI1(INV) above. | | | | |



### Group 41: Process PID Set 2

This group defines second set of parameters used with the Process PID (PID1) controller.

The operation of parameters 4101…4126 is analogous with Process PID set 1 (PID1) parameters 4001…4026.

PID parameter set 2 can be selected by parameter 4027 PID 1 PARAM SET.

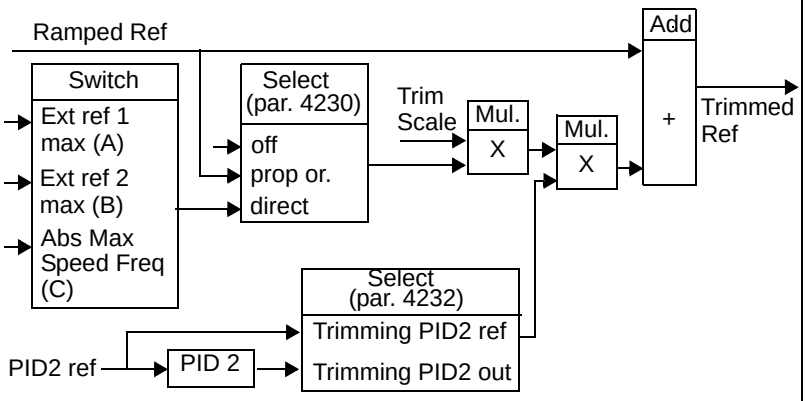
| Group 41: Process PID Set 2 | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 4101 … 4126 | See 4001 …4026 | | | | |

### Group 42: External PID

This group defines the parameters used for the second PID controller (PID2) of ACH550

The operation of parameters 4201…4221 is analogous with Process PID set 1 (PID1) parameters 4001…4021.

| Group 42: External PID | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 4201 … 4221 | See 4001 …4021 | | | | |
| 4228 | **ACTIVATE**<br>Defines the source for enabling the external PID function.<br>• Requires 4230 TRIM MODE = 0 NOT SEL.<br>0 = NOT SEL – Disables external PID control.<br>1 = DI1 – Defines digital input DI1 as the control for enabling external PID control.<br>• Activating the digital input enables external PID control.<br>• De-activating the digital input disables external PID control.<br>2…6 = DI2…DI6 – Defines digital input DI2…DI6 as the control for enabling external PID control.<br>• See DI1 above.<br>7 = DRIVE RUN – Defines the start command as the control for enabling external PID control.<br>• Activating the start command (drive is running) enables external PID control.<br>8 = ON – Defines the power-on as the control for enabling external PID control.<br>• Activating power to the drive enables external PID control.<br>9…12 = TIMER 1…4 – Defines the Timer as the control for enabling external PID control (Timer active enables external PID control).<br>• See parameter Group 36: Timer Functions.<br>-1 = DI1(INV) – Defines an inverted digital input DI1 as the control for enabling external PID control.<br>• Activating the digital input disables external PID control.<br>• De-activating the digital input enables external PID control.<br>-2…-6 = DI2(INV)…DI6(INV) – Defines digital input DI2…DI6 as the control for enabling external PID control.<br>• See DI1(INV) above. | **-6…12** | **-** | **0** | |
| 4229 | **OFFSET**<br>Defines the offset for the PID output.<br>• When PID is activated, output starts from this value.<br>• When PID is deactivated, output resets to this value.<br>• Parameter is not active when 4230 TRIM MODE not = 0 (trim mode is active). | **0.0…100.0%** | **0.1%** | **0.0%** | |
| 4230 | **TRIM MODE**<br>Selects the type of trim, if any. Using the trim it is possible to combine a corrective factor to the drive reference.<br>0 = NOT SEL – Disables the trim function.<br>1 = PROPORTIONAL – Adds a trim factor that is proportional to the rpm/Hz reference.<br>2 = DIRECT – Adds a trim factor based on the control loop's maximum limit. | **0…2** | **1** | **0** | |
| 4231 | **TRIM SCALE**<br>Defines the multiplier (as a percent, plus or minus) used in the trim mode. | **-100.0%…100.0%** | **0.1%** | **0.0%** | |

| Group 42: External PID | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 4232 | **CORRECTION SRC** | **1…2** | **1** | **1** | |
| | Defines the trimming reference for the correction source.<br>1 = PID2 REF – Uses appropriate REF MAX (SWITCH A OR B):<br>• 1105 REF 1 MAX when REF1 is active (A).<br>• 1108 REF 2 MAX when REF2 is active (B).<br>2 = PID2 OUTPUT – Uses the absolute maximum speed or frequency (Switch C):<br>• 2002 MAXIMUM SPEED if 9904 MOTOR CONTROL MODE = 1 SPEED or 2 TORQUE.<br>• 2008 MAXIMUM FREQUENCY IF 9904 MOTOR CONTROL MODE = 3 SCALAR. |  | | | |

### Group 51: Ext Comm Module

This group defines set-up variables for a fieldbus adaptor (FBA) communication module. For more information on these parameters, refer to the user's manualation supplied with the FBA module.

| Group 51: Ext Comm Module | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 5101 | **FBA TYPE**<br>Displays the type of the connected fieldbus adapter module.<br>0 = NOT DEFINED – Module not found, or not properly connected, or parameter 9802 is not set to 4 (EXT FBA).<br>1 = PROFIBUS-DP –<br>16 = INTERBUS –<br>21 = LONWORKS –<br>32 = CANOPEN –<br>37 = DEVICENET –<br>64 = MODBUS PLUS –<br>101 = CONTROLNET –<br>128 = ETHERNET – | **-** | **1** | **0** | |
| 5102<br>…<br>5126 | **FB PAR 2…FB PAR 26**<br>For more information on these parameters, refer to the user's manual supplied with the FBA module. | **0...65535** | **1** | **0** | |
| 5127 | **FBA PAR REFRESH**<br>Validates any changed fieldbus parameter settings.<br>• After refreshing, the value reverts automatically to DONE. | **0, 1** | **1** | **0** | |
| 5128 | **FILE CPI FW REV**<br>Displays the CPI firmware revision of the drive's fieldbus adapter configuration file. Format is xyz where:<br>• x = major revision number<br>• y = minor revision number<br>• z = correction number<br>**Example:** 107 = revision 1.07 | **0000…FFFF hex** | **1** | **0000 hex** | |
| 5129 | **FILE CONFIG ID**<br>Displays the revision of the drive's fieldbus adapter module's configuration file identification.<br>• File configuration information is drive application program-dependent. | **0000…FFFF hex** | **1** | **0000 hex** | |
| 5130 | **FILE CONFIG REV**<br>Contains the revision of the drive's fieldbus adapter module configuration file.<br>**Example:** 1 = revision 1 | **0000…FFFF hex** | **1** | **0000 hex** | |
| 5131 | **FBA STATUS**<br>Contains the status of the adapter module.<br>0 = IDLE – Adapter not configured.<br>1 = EXEC. INIT – Adapter is initializing.<br>2 = TIME OUT – A timeout has occurred in the communication between the adapter and the drive.<br>3 = CONFIG ERROR – Adapter configuration error.<br>• The major or minor revision code of the adapter's CPI firmware revision differs from that stated in the drive's configuration file.<br>4 = OFF-LINE – Adapter is off-line.<br>5 = ON-LINE – Adapter is on-line.<br>6 = RESET – Adapter is performing a hardware reset. | **0…6** | **1** | **0** | |
| 5132 | **FBA CPI FW REV**<br>Contains the revision of the module's CPI program. Format is xyz where:<br>• x = major revision number<br>• y = minor revision number<br>• z = correction number<br>**Example:** 107 = revision 1.07 | **0000…FFFF hex** | **1** | **0000 hex** | |

| Group 51: Ext Comm Module | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 5133 | **FBA APPL FW REV** | **0000…FFFF hex** | **1** | **0000 hex** | |
| | Contains the revision of the module's application program Format is xyz where:<br>• x = major revision number<br>• y = minor revision number<br>• z = correction number<br>**Example:** 107 = revision 1.07 | | | | |

### Group 52: Panel Communication

This group defines the communication settings for the control panel port on the drive. Normally, when using the supplied control panel, there is no need to change settings in this group.

In this group, parameter modifications take effect on the next power-up.

| Group 52: Panel Communication | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 5201 | **STATION ID**<br>Defines the address of the drive.<br>• Two units with the same address are not allowed on-line.<br>• Range: 1…247 | **1…247** | **1** | **1** | |
| 5202 | **BAUDRATE**<br>Defines the communication speed of the drive in kbits per second (kbits/s).<br>9.6<br>19.2<br>38.4<br>57.6<br>115.2 | **9.6…115.2 kbits/s** | **-** | **9.6 kbits/s** | |
| 5203 | **PARITY**<br>Sets the character format to be used with the panel communication.<br>0 = 8N1 – No parity, one stop bit.<br>1 = 8N2 – No parity, two stop bits.<br>2 = 8E1 – Even parity, one stop bit.<br>3 = 8O1 – Odd parity, one stop bit. | **0…3** | **1** | **0** | |
| 5204 | **OK MESSAGES**<br>Contains a count of valid Modbus messages received by the drive.<br>• During normal operation, this counter is increasing constantly. | **0…65535** | **1** | **-** | |
| 5205 | **PARITY ERRORS**<br>Contains a count of the characters with a parity error that is received from the fieldbus. For high counts, check:<br>• Parity settings of devices connected on the fieldbus – they must not differ.<br>• Ambient electro-magnetic noise levels – high noise levels generate errors. | **0…65535** | **1** | **-** | |
| 5206 | **FRAME ERRORS**<br>Contains a count of the characters with a framing error that the fieldbus receives. For high counts, check:<br>• Communication speed settings of devices connected on the fieldbus – they must not differ.<br>• Ambient electro-magnetic noise levels – high noise levels generate errors. | **0…65535** | **1** | **-** | |
| 5207 | **BUFFER OVERRUNS**<br>Contains a count of the characters received that cannot be placed in the buffer.<br>• Longest possible message length for the drive is 128 bytes.<br>• Received messages exceeding 128 bytes overflow the buffer. The excess characters are counted. | **0…65535** | **1** | **-** | |
| 5208 | **CRC ERRORS**<br>Contains a count of the messages with a CRC error that the drive receives. For high counts, check:<br>• Ambient electro-magnetic noise levels – high noise levels generate errors.<br>• CRC calculations for possible errors. | **0…65535** | **1** | **-** | |

### Group 53: EFB Protocol

This group defines set-up variables used for an embedded fieldbus (EFB) communication protocol. Refer to communication protocol documentation for more information on these parameters.

| Group 53: EFB Control | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 5301 | **EFB PROTOCOL ID**<br>Contains the identification and program revision of the protocol.<br>• Format: XXYY, where xx = protocol ID, and YY = program revision. | **0000…FFFF hex** | **1** | **0000 hex** | |
| 5302 | **EFB STATION ID**<br>Defines the node address of the RS485 link.<br>• The node address on each unit must be unique. | **0…65535** | **1** | **1** | ✓ |
| 5303 | **EFB BAUD RATE**<br>Defines the communication speed of the RS485 link in kbits per second (kbits/s).<br>1.2 kbits/s<br>2.4 kbits/s<br>4.8 kbits/s<br>9.6 kbits/s<br>19.2 kbits/s<br>38.4 kbits/s<br>57.6 kbits/s | **1.2…57.6 kbits/s** | **-** | **9.6 kbits/s** | |
| 5304 | **EFB PARITY**<br>Defines the data length parity and stop bits to be used with the RS485 link communication.<br>• The same settings must be used in all on-line stations.<br>0 = 8N1 – 8 data bits, No parity, one stop bit.<br>1 = 8N2 – 8 data bits, No parity, two stop bits.<br>2 = 8E1 – 8 data bits, Even parity, one stop bit.<br>3 = 8O1 – 8 data bits, Odd parity, one stop bit. | **0…3** | | **0** | |
| 5305 | **EFB CTRL PROFILE**<br>Selects the communication 1=ACH550 profile used by the EFB protocol.<br>0 = ABB DRIVES – Operation of Control Word and Status Word conforms to ABB Drives Profile.<br>1 = ACH550 – Alternate 32 bit profile (Advanced users only). | **0, 1** | **1** | **0** | |
| 5306 | **EFB OK MESSAGES**<br>Contains a count of valid messages received by the drive.<br>• During normal operation, this counter is increasing constantly. | **0…65535** | **1** | **0** | |
| 5307 | **EFB CRC ERRORS**<br>Contains a count of the messages with a CRC error received by the drive. For high counts, check:<br>• Ambient electro-magnetic noise levels – high noise levels generate errors.<br>• CRC calculations for possible errors. | **0…65535** | **1** | **0** | |
| 5308 | **EFB UART ERRORS**<br>Contains a count of the messages with a character error received by the drive. | **0…65535** | **1** | **0** | |
| 5309 | **EFB STATUS**<br>Contains the status of the EFB protocol.<br>0 = IDLE – EFB protocol is configured, but not receiving any messages.<br>1 = EXEC. INIT – EFB protocol is initializing.<br>2 = TIME OUT – A timeout has occurred in the communication between the network master and the EFB protocol.<br>3 = CONFIG ERROR – EFB protocol has a configuration error.<br>4 = OFF-LINE – EFB protocol is receiving messages that are NOT addressed to this drive.<br>5 = ON-LINE – EFB protocol is receiving messages that are addressed to this drive.<br>6 = RESET – EFB protocol is performing a hardware reset.<br>7 = LISTEN ONLY – EFB protocol is in listen-only mode. | **0…7** | **1** | **0** | |

| Group 53: EFB Control | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 5310 | **EFB PAR 10**<br>Specifies the parameter mapped to Modbus Register 40005. | **0…65535** | **1** | **0** | |
| 5311 | **EFB PAR 11**<br>Specifies the parameter mapped to Modbus Register 40006. | **0…65535** | **1** | **0** | |
| 5312 | **EFB PAR 12**<br>Specifies the parameter mapped to Modbus Register 40007. | **0…65535** | **1** | **0** | |
| 5313 | **EFB PAR 13**<br>Specifies the parameter mapped to Modbus Register 40008. | **0…65535** | **1** | **0** | |
| 5314 | **EFB PAR 14**<br>Specifies the parameter mapped to Modbus Register 40009. | **0…65535** | **1** | **0** | |
| 5315 | **EFB PAR 15**<br>Specifies the parameter mapped to Modbus Register 40010. | **0…65535** | **1** | **0** | |
| 5316 | **EFB PAR 16**<br>Specifies the parameter mapped to Modbus Register 40011. | **0…65535** | **1** | **0** | |
| 5317 | **EFB PAR 17**<br>Specifies the parameter mapped to Modbus Register 40012. | **0…65535** | **1** | **0** | |
| 5318<br>…<br>5320 | **EFB PAR 18…EFB PAR 20**<br>**Reserved.** | **0…65535** | **1** | **0** | |

### Group 81: PFA

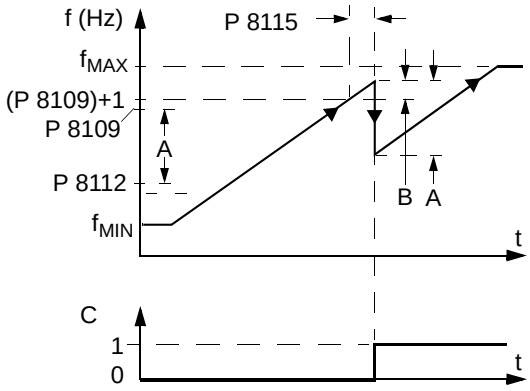
This group defines a Pump and Fan Alternation (PFA) mode of operation. The major features of PFA are:

- The ACH550 controls the motor of pump no. 1, varying the motor speed to control the pump capacity. This motor is the speed regulated motor.
- Direct line connections power the motor of pump no. 2 and pump no.3, etc. The ACH550 switches pump no. 2 (and then pump no. 3, etc.) on and off as needed. These motors are auxiliary motors.
- The ACH550 PID control uses two signals: a process reference and an actual value feedback. The PID controller adjusts the speed (frequency) of the first pump such that the actual value follows the process reference.
- When demand (defined by the process reference) exceeds the first motor's capacity (user defined as a frequency limit), the PFA automatically starts an auxiliary pump. The PFA also reduces the speed of the first pump to account for the auxiliary pump's addition to total output. Then, as before, the PID controller adjusts the speed (frequency) of the first pump such that the actual value follows the process reference. If demand continues to increase, PFA adds additional auxiliary pumps, using the same process.
- When demand drops, such that the first pump speed falls below a minimum limit (user defined by a frequency limit), the PFA automatically stops an auxiliary pump. The PFA also increases the speed of the first pump to account for the auxiliary pump's missing output.
- An Interlock function (when enabled) identifies off-line (out of service) motors, and the PFA skips to the next available motor in the sequence.

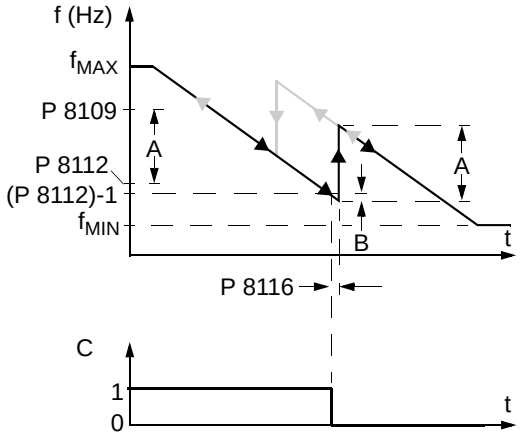
An Autochange function (when enabled and with the appropriate switchgear) equalizes duty time between the pump motors. Autochange periodically increments the position of each motor in the rotation – the speed regulated motor becomes the last auxiliary motor, the first auxiliary motor becomes the speed regulated motor, etc.

| Group 81: PFA | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 8103 | **REFERENCE STEP 1** | **0.0…100.0%** | **0.1%** | **0.0%** | |
| | Sets a percentage value that is added to the process reference.<br>• Applies only when at least one auxiliary (constant speed) motor is running.<br>• Default value is 0%.<br>Example: An ACH550 operates three parallel pumps that maintain water pressure in a pipe.<br>• 4011 INTERNAL SETPNT sets a constant pressure reference that controls the pressure in the pipe.<br>• The speed regulated pump operates alone at low water consumption levels.<br>• As water consumption increases, first one constant speed pump operates, then, the second.<br>• As flow increases, the pressure at the output end of the pipe drops relative to the pressure measured at the input end. As auxiliary motors step in to increase the flow, the adjustments below correct the reference to more closely match the output pressure.<br>• When the first auxiliary pump operates, increase the reference with parameter 8103 REFERENCE STEP 1.<br>• When both auxiliary pumps operate, increase the reference with parameter 8103 reference step 1 + parameter 8104 reference step 2.<br>• When three auxiliary pumps operate, increase the reference with parameter 8103 REFERENCE STEP 1 + parameter 8104 REFERENCE STEP 2 + parameter 8105 REFERENCE STEP 3. | | | | |

| Group 81: PFA | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 8104 | **REFERENCE STEP 2** | **0.0…100.0%** | **0.1%** | **0.0%** | |
| | Sets a percentage value that is added to the process reference.<br>• Applies only when at least two auxiliary (constant speed) motors are running.<br>• See parameter 8103 REFERENCE STEP1. | | | | |
| 8105 | **REFERENCE STEP 3** | **0.0…100.0%** | **0.1%** | **0.0%** | |
| | Sets a percentage value that is added to the process reference.<br>• Applies only when at least three auxiliary (constant speed) motors are running.<br>• See parameter 8103 REFERENCE STEP1. | | | | |
| 8109 | **START FREQ 1** | **0.0…500.0 Hz** | **0.1 Hz** | **60.0 (US)** | |
| | Sets the frequency limit used to start the first auxiliary motor. The first auxiliary motor starts if:<br>• No auxiliary motors are running.<br>• ACH550 output frequency exceeds the limit: 8109 + 1 Hz.<br>• Output frequency stays above a relaxed limit (8109 - 1 Hz) for at least the time: 8115 AUX MOT START D.<br>After the first auxiliary motor starts:<br>• Output frequency decreases by the value = (8109 START FREQ 1) - (8112 LOW FREQ 1).<br>• In effect, the output of the speed regulated motor drops to compensate for the input from the auxiliary motor.<br>See figure, where:<br>• A = (8109 START FREQ 1) - (8112 LOW FREQ 1)<br>• B = Output frequency increase during the start delay.<br>• C = Diagram showing auxiliary motor's run status as frequency increases (1 = On).<br>Note! 8109 START FREQ 1 value must be between:<br>• 8112 LOW FREQ 1<br>• (2008 MAXIMUM FREQ) -1. | | | | |
| 8110 | **START FREQ 2** | **0.0…500.0 Hz** | **0.1 Hz** | **60.0 (US)** | |
| | Sets the frequency limit used to start the second auxiliary motor.<br>• See 8109 START FREQ 1 for a complete description of the operation.<br>The second auxiliary motor starts if:<br>• One auxiliary motor is running.<br>• ACH550 output frequency exceeds the limit: 8110 + 1.<br>• Output frequency stays above the relaxed limit (8110 - 1 Hz) for at least the time: 8115 AUX MOT START D. | | | | |
| 8111 | **START FREQ 3** | **0.0…500.0 Hz** | **0.1 Hz** | **60.0 (US)** | |
| | Sets the frequency limit used to start the third auxiliary motor.<br>• See 8109 START FREQ 1 for a complete description of the operation.<br>The third auxiliary motor starts if:<br>• Two auxiliary motors are running.<br>• ACH550 output frequency exceeds the limit: 8111 + 1 Hz.<br>• Output frequency stays above the relaxed limit (8111 - 1 Hz) for at least the time: 8115 AUX MOT START D. | | | | |



| Group 81: PFA | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 8112 | **LOW FREQ 1** | **0.0…500.0 Hz** | **0.1 Hz** | **30.0 (US)** | |
| | Sets the frequency limit used to stop the first auxiliary motor. The first auxiliary motor stops if:<br>• The first auxiliary motor is running alone.<br>• ACH550 output frequency drops below the limit: 8112 - 1.<br>• Output frequency stays below the relaxed limit (8112 + 1 Hz) for at least the time: 8116 AUX MOT STOP D.<br>After the first auxiliary motor stops:<br>• Output frequency increases by the value = (8109 START FREQ 1) - (8112 LOW FREQ 1).<br>• In effect, the output of the speed regulated motor increases to compensate for the loss of the auxiliary motor.<br>See figure, where:<br>• A = (8109 START FREQ 1) - (8112 LOW FREQ 1)<br>• B = Output frequency decrease during the stop delay.<br>• C = Diagram showing auxiliary motor's run status as frequency decreases (1 = On).<br>• Grey path = Shows hysteresis – if time is reversed, the path backwards is not the same. For details on the path for starting, see the diagram at 8109 START FREQ 1.<br>Note! Low Frequency 1 value must be between:<br>• (2007 MINIMUM FREQ) +1.<br>• 8109 START FREQ 1 | | | | |
| 8113 | **LOW FREQ 2** | **0.0…500.0 Hz** | **0.1 Hz** | **30.0 Hz (US)** | |
| | Sets the frequency limit used to stop the second auxiliary motor.<br>• See 8112 LOW FREQ 1 for a complete description of the operation.<br>The second auxiliary motor stops if:<br>• Two auxiliary motors are running.<br>• ACH550 output frequency drops below the limit: 8113 - 1.<br>• Output frequency stays below the relaxed limit (8113 + 1 Hz) for at least the time: 8116 AUX MOT STOP D. | | | | |
| 8114 | **LOW FREQ 3** | **0.0…500.0 Hz** | **0.1 Hz** | **30.0 Hz (US)** | |
| | Sets the frequency limit used to stop the third auxiliary motor.<br>• See 8112 LOW FREQ 1 for a complete description of the operation.<br>The third auxiliary motor stops if:<br>• Three auxiliary motors are running.<br>• ACH550 output frequency drops below the limit: 8114 - 1.<br>• Output frequency stays below the relaxed limit (8114 + 1 Hz) for at least the time: 8116 AUX MOT STOP D. | | | | |
| 8115 | **AUX MOT START D** | **0.0…3600.0 s** | **0.1 s; 1 s** | **5.0 s** | |
| | Sets the Start Delay for the auxiliary motors.<br>• The output frequency must remain above the start frequency limit (parameter 8109, 8110, or 8111) for this time period before the auxiliary motor starts.<br>• See 8109 START FREQ 1 for a complete description of the operation. | | | | |
| 8116 | **AUX MOT STOP D.** | **0.0…3600.0 s** | **0.1 s; 1 s** | **3.0 s** | |
| | Sets the Stop Delay for the auxiliary motors.<br>• The output frequency must remain below the low frequency limit (parameter 8112, 8113, or 8114) for this time period before the auxiliary motor stops.<br>• See 8112 LOW FREQ 1 for a complete description of the operation. | | | | |



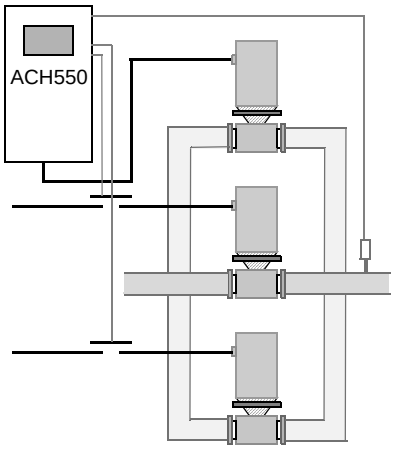
| Group 81: PFA | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 8117 | **NR OF AUX MOT** | **0…3** | **1** | **1** | ✓ |

Sets the number of auxiliary motors.
- Each auxiliary motor requires a relay output, which the drive uses to send start/stop signals.
- The Autochange function, if used, requires an additional relay output for the speed regulated motor.

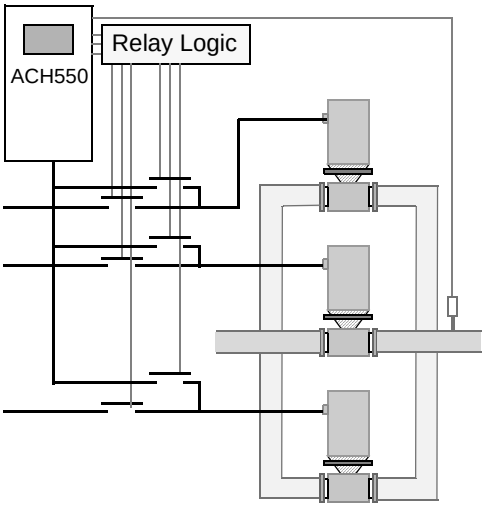
The following describes the set-up of the required relay outputs.

**Relay Outputs**

As noted above, each auxiliary motor requires a relay output, which the drive uses to send start/stop signals. The following describes how the drive keeps track of motors and relays.
- The ACH550 provides relay outputs RO1…RO3.
- An external digital output module can be added to provide relay outputs RO4…RO6.
- Parameters 1401…1403 and 1410…1412 define, respectively, how relays RO1…RO6 are used – the parameter value 31 PFA defines the relay as used for PFA.
- The ACH550 assigns auxiliary motors to relays in ascending order. If the Autochange function is disabled, the first auxiliary motor is the one connected to the first relay with a parameter setting = 31 PFA, and so on. If the Autochange function is used, the assignments rotate. Initially, the speed regulated motor is the one connected to the first relay with a parameter setting = 31 PFA, the first auxiliary motor is the one connected to the second relay with a parameter setting = 31 PFA, and so on




Standard PFA mode




PFA with Autochange mode

- The table below shows the ACH550 PFA motor assignments for some typical settings in the Relay Output parameters (1401…1403 and 1410…1412), where the settings are either =31 (PFA), or =X (anything but 31), and where the Autochange function is disabled (8118 AUTOCHNG INTERV = 0).

| Parameter Setting | | | | | | | ACH550 Relay Assignment | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Autochange Disabled | | | | | |
| 1401 | 1402 | 1403 | 1410 | 1411 | 1412 | 8117 | RO1 | RO2 | RO3 | RO4 | RO5 | RO6 |
| 31 | X | X | X | X | X | 1 | Aux. | X | X | X | X | X |
| 31 | 31 | X | X | X | X | 2 | Aux. | Aux. | X | X | X | X |
| 31 | 31 | 31 | X | X | X | 3 | Aux. | Aux. | Aux. | X | X | X |
| X | 31 | 31 | X | X | X | 2 | X | Aux. | Aux. | X | X | X |
| X | X | X | 31 | X | 31 | 2 | X | X | X | Aux. | X | Aux. |
| 31 | 31 | X | X | X | X | 1* | Aux. | Aux. | X | X | X | X |

* =One additional relay output for the PFA that is in use.

One motor is in "sleep" when the other is rotating.

**Group 81: PFA**

| Code | Description | Range | Resolution | Default | S |
|---|---|---|---|---|---|

The table below shows the ACH550 PFA motor assignments for some typical settings in the Relay Output parameters (1401…1403 and 1410…1412), where the settings are either =31 (PFA), or =X (anything but 31), and where the Autochange function is enabled (8118 AUTOCHNG INTERV = value > 0).v

| Parameter Setting | | | | | | | ACH550 Relay Assignment | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Autochange Enabled | | | | | |
| 1401 | 1402 | 1403 | 1410 | 1411 | 1412 | 8117 | RO1 | RO2 | RO3 | RO4 | RO5 | RO6 |
| 31 | 31 | X | X | X | X | 1 | PFA | PFA | X | X | X | X |
| 31 | 31 | 31 | X | X | X | 2 | PFA | PFA | PFA | X | X | X |
| x | 31 | 31 | X | X | X | 1 | X | PFA | PFA | X | X | X |
| X | X | X | 31 | X | 31 | 1 | X | X | X | PFA | X | PFA |
| 31 | 31 | X | X | X | X | 0** | PFA | PFA | X | X | X | X |

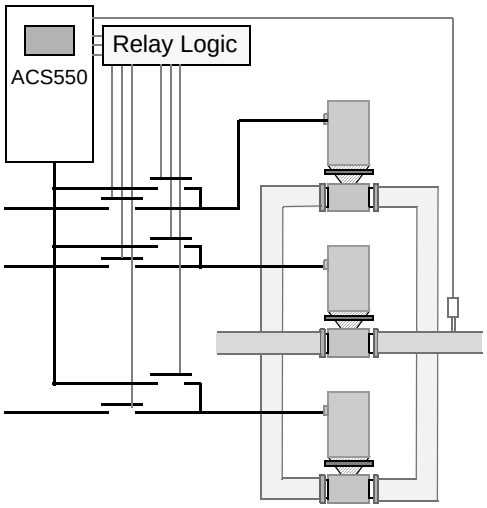
** = No auxiliary motors, but the autochange function is in use. Working as standard PID-control.

8118 **AUTOCHNG INTERV** **0.0…336.0 h** **0.1 h** **0.0** ✓

Controls operation of the Autochange function and sets the interval between changes.
- The Autochange time interval only applies to the time when the speed regulated motor is running.
- See parameter 8119 AUTOCHNG LEVEL for an overview of the Autochange function.
- The drive always coasts to a stop when autochange is performed.
- Autochange enabled requires parameter 8120 INTERLOCKS = value > 0.

0.0 = NOT SEL – Disables the Autochange function.
0.1…336 = The operating time interval (the time when the start signal is on) between automatic motor changes.

**Warning! When enabled, the Autochange function requires the interlocks (8120 interlocks = value > 0) enabled. During autochange the drive's power output is interrupted and the drive coasts to stop, preventing damage to the contacts.**



PFA with Autochange mode

8119 **AUTOCHNG LEVEL** **0.0…100.0%** **0.1%** **50.0%**

Sets an upper limit, as a percent of output capacity, for the autochange logic. When the output from the PID/PFA control block exceeds this limit, autochange is prevented. For example, use this parameter to deny autochange when the Pump-Fan system is operating near maximum capacity.

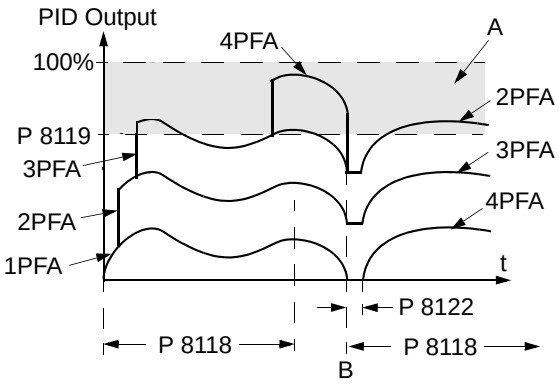
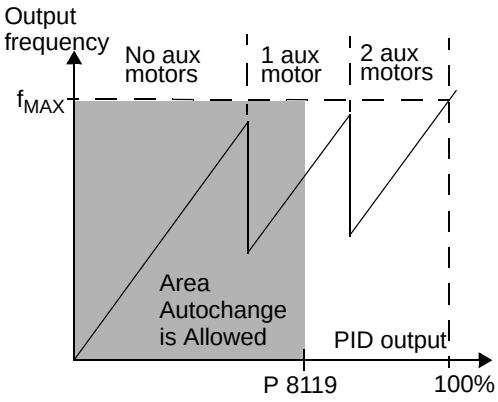
**Autochange Overview**

The purpose of the autochange operation is to equalize duty time between multiple motors used in a system. At each autochange operation:
- A different motor takes a turn connected to the ACH550 output – the speed regulated motor.
- The starting order of the other motors rotates.

The Autochange function requires:
- External switchgear for changing the dive's output power connections.
- Parameter 8120 INTERLOCKS = value > 0.

Autochange is performed when:
- The running time since the previous autochange reaches the time set by 8118 AUTOCHNG INTERV
- The PFA input is below the level set by this parameter, 8119 AUTOCHNG LEVEL.

**Note!** The ACH550 always coasts to stop when autochange is performed.

| Group 81: PFA | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| | In an autochange, the Autochange function does all of the following (see figure):<br>• Initiates a change when the running time, since the last autochange, reaches 8118 AUTOCHNG INTERV, and PFA input is below limit 8119 AUTOCHNG LEVEL.<br>• Stops the speed regulated motor.<br>• Switches off the contactor of the speed regulated motor.<br>• Increments the starting order counter, to change the starting order for the motors.<br>• Identifies the next motor in line to be the speed regulated motor.<br>• Switches off the above motor's contactor, if the motor was running. Any other running motors are not interrupted.<br>• Switches on the contactor of the new speed regulated motor. The autochange switchgear connects this motor to the ACH550 power output.<br>• Delays motor start for the time 8122 PFA START DELAY.<br>• Starts the speed regulated motor.<br>• Identifies the next constant speed motor in the rotation.<br>• Switches the above motor on, but only if the new speed regulated motor had been running (as a constant speed motor) – This step keeps an equal number of motors running before and after autochange.<br>• Continues with normal PFA operation.<br>  <br><br>A = Area above 8119 AUTOCHNG LEVEL – autochange not allowed.<br>B = Autochange occurs.<br>1PFA, etc. = PID output associated with each motor.<br>**Starting Order Counter**<br>The operation of the starting-order counter:<br>• The relay output parameter definitions (1401…1403 and 1410…1412)) establish the initial motor sequence. (The lowest parameter number with a value 31 (PFA) identifies the relay connected to 1PFA, the first motor, and so on.)<br>• Initially, 1PFA = speed regulated motor, 2PFA = 1st auxiliary motor, etc.<br>• The first autochange shifts the sequence to: 2PFA = speed regulated motor, 3PFA = 1st auxiliary motor, …, 1PFA = last auxiliary motor.<br>• The next autochange shifts the sequence again, and so on.<br>• If the autochange cannot start a needed motor because all inactive motors are interlocked, the drive displays an alarm (2051, PFA INTERLOCK).<br>  <br><br>• When ACH550 power supply is switched off, the counter preserves the current Autochange rotation positions in permanent memory. When power is restored, the Autochange rotation starts at the position stored in memory.<br>• If the PFA relay configuration is changed (or if the PFA enable value is changed), the rotation is reset. (See the first bullet above.) | | | | |
| 8120 | **INTERLOCKS** | **0…6** | **1** | **4** | ✓ |
| | Defines operation of the Interlock function. When the Interlock function is enabled:<br>• An interlock is active when its command signal is absent.<br>• An interlock is inactive when its command signal is present.<br>• The ACH550 will not start if a start command occurs when the speed regulated motor's interlock is active – the control panel displays an alarm (2015, PFA INTERLOCK). | | | | |

| Group 81: PFA | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |

Wire each Interlock circuit as follows:
- Wire a contact of the motor's On/Off switch to the Interlock circuit – the drive's PFA logic can then recognize that the motor is switched off, and start the next available motor.
- Wire a contact of the motor thermal relay (or other protective device in the motor circuit) to the Interlock input – the drive's PFA logic can then recognize that a motor fault is activated and stop the motor.

0 = NOT SEL – Disables the Interlock function. All digital inputs are available for other purposes.
- Requires 8118 AUTOCHNG INTERV = 0 (The Autochange function must be disabled if Interlock function is disabled.)

1 = DI1 – Enables the Interlock function, and assigns a digital input (starting with DI1) to the interlock signal for each PFA relay. These assignments are defined in the following table and depend on:

The number of PFA relays (number of parameters 1401…1403 and 1410…1412) with value = 31 (PFA).

The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).

| No. PFA Relays | Autochange Disabled (P 8118) | Autochange Enabled (P 8118) |
|---|---|---|
| 0 | DI1: Speed Reg Motor<br>DI2…DI6: Free | Not allowed |
| 1 | DI1: Speed Reg Motor<br>DI2: First PFA Relay<br>DI3…DI6: Free | DI1: First PFA Relay<br>DI2…DI6: Free |
| 2 | DI1: Speed Reg Motor<br>DI2: First PFA Relay<br>DI3: Second PFA Relay<br>DI4…DI6: Free | DI1: First PFA Relay<br>DI2: Second PFA Relay<br>DI3…DI6: Free |
| 3 | DI1: Speed Reg Motor<br>DI2: First PFA Relay<br>DI3: Second PFA Relay<br>DI4: Third PFA Relay<br>DI5…DI6: Free | DI1: First PFA Relay<br>DI2: Second PFA Relay<br>DI3: Third PFA Relay<br>DI4…DI6: Free |
| 4 | DI1: Speed Reg Motor<br>DI2: First PFA Relay<br>DI3: Second PFA Relay<br>DI4: Third PFA Relay<br>DI5: Fourth PFA Relay<br>DI6: Free | DI1: First PFA Relay<br>DI2: Second PFA Relay<br>DI3: Third PFA Relay<br>DI4: Fourth PFA Relay<br>DI5…DI6: Free |
| 5 | DI1: Speed Reg Motor<br>DI2: First PFA Relay<br>DI3: Second PFA Relay<br>DI4: Third PFA Relay<br>DI5: Fourth PFA Relay<br>DI6: Fifth PFA Relay | DI1: First PFA Relay<br>DI2: Second PFA Relay<br>DI3: Third PFA Relay<br>DI4: Fourth PFA Relay<br>DI5: Fifth PFA Relay<br>DI6: Free |
| 6 | Not allowed | DI1: First PFA Relay<br>DI2: Second PFA Relay<br>DI3: Third PFA Relay<br>DI4: Fourth PFA Relay<br>DI5: Fifth PFA Relay<br>DI6: Sixth PFA Relay |

| Group 81: PFA | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |

2 = DI2 – Enables the Interlock function, and assigns a digital input (starting with DI2) to the interlock signal for each PFA relay. These assignments are defined in the following table and depend on:
- The number of PFA relays (number of parameters 1401…1403 and 1410…1412) with value = 31 (PFA).
- The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).

| No. PFA Relays | Autochange Disabled (P 8118) | Autochange Enabled (P 8118) |
|---|---|---|
| 0 | DI1: Free<br>DI2: Speed Reg Motor<br>DI3…DI6: Free | Not allowed |
| 1 | DI1: Free<br>DI2: Speed Reg Motor<br>DI3: First PFA Relay<br>DI4…DI6: Free | DI1: Free<br>DI2: First PFA Relay<br>DI3…DI6: Free |
| 2 | DI1: Free<br>DI2: Speed Reg Motor<br>DI3: First PFA Relay<br>DI4: Second PFA Relay<br>DI5…DI6: Free | DI1: Free<br>DI2: First PFA Relay<br>DI3: Second PFA Relay<br>DI4…DI6: Free |
| 3 | DI1: Free<br>DI2: Speed Reg Motor<br>DI3: First PFA Relay<br>DI4: Second PFA Relay<br>DI5: Third PFA Relay<br>DI6: Free | DI1: Free<br>DI2: First PFA Relay<br>DI3: Second PFA Relay<br>DI4: Third PFA Relay<br>DI5…DI6: Free |
| 4 | DI1: Free<br>DI2: Speed Reg Motor<br>DI3: First PFA Relay<br>DI4: Second PFA Relay<br>DI5: Third PFA Relay<br>DI6: Fourth PFA Relay | DI1: Free<br>DI2: First PFA Relay<br>DI3: Second PFA Relay<br>DI4: Third PFA Relay<br>DI5: Fourth PFA Relay<br>DI6: Free |
| 5 | Not allowed | DI1: Free<br>DI2: First PFA Relay<br>DI3: Second PFA Relay<br>DI4: Third PFA Relay<br>DI5: Fourth PFA Relay<br>DI6: Fifth PFA Relay |
| 6 | Not allowed | Not allowed |

| Group 81: PFA | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |

3 = DI3 – Enables the Interlocks function, and assigns a digital input (starting with DI3) to the interlock signal for each PFA relay. These assignments are defined in the following table and depend on:
- The number of PFA relays (number of parameters 1401…1403 and 1410…1412) with value = 31 (PFA).
- The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).

| No. PFA Relays | Autochange Disabled (P 8118) | Autochange Enabled (P 8118) |
|---|---|---|
| 0 | DI1…DI2: Free<br>DI3: Speed Reg Motor<br>DI4…DI6: Free | Not allowed |
| 1 | DI1…DI2: Free<br>DI3: Speed Reg Motor<br>DI4: First PFA Relay<br>DI5…DI6: Free | DI1…DI2: Free<br>DI3: First PFA Relay<br>DI4…DI6: Free |
| 2 | DI1…DI2: Free<br>DI3: Speed Reg Motor<br>DI4: First PFA Relay<br>DI5: Second PFA Relay<br>DI6: Free | DI1…DI2: Free<br>DI3: First PFA Relay<br>DI4: Second PFA Relay<br>DI5…DI6: Free |
| 3 | DI1…DI2: Free<br>DI3: Speed Reg Motor<br>DI4: First PFA Relay<br>DI5: Second PFA Relay<br>DI6: Third PFA Relay | DI1…DI2: Free<br>DI3: First PFA Relay<br>DI4: Second PFA Relay<br>DI5: Third PFA Relay<br>DI6: Free |
| 4 | Not allowed | DI1…DI2: Free<br>DI3: First PFA Relay<br>DI4: Second PFA Relay<br>DI5: Third PFA Relay<br>DI6: Fourth PFA Relay |
| 5…6 | Not allowed | Not allowed |

- INTERV = 0, and otherwise enabled).

4 = DI4 – Enables the Interlock function, and assigns a digital input (starting with DI4) to the interlock signal for each PFA relay. These assignments are defined in the following table and depend on:
- The number of PFA relays (number of parameters 1401…1403 and 1410…1412) with value = 31 (PFA).

The Autochange function status (disabled if 8118 AUTOCHNG

| No. PFA Relays | Autochange Disabled (P 8118) | Autochange Enabled (P 8118) |
|---|---|---|
| 0 | DI1…DI3: Free<br>DI4: Speed Reg Motor<br>DI5…DI6: Free | Not allowed |
| 1 | DI1…DI3: Free<br>DI4: Speed Reg Motor<br>DI5: First PFA Relay<br>DI6: Free | DI1…DI3: Free<br>DI4: First PFA Relay<br>DI5…DI6: Free |
| 2 | DI1…DI3: Free<br>DI4: Speed Reg Motor<br>DI5: First PFA Relay<br>DI6: Second PFA Relay | DI1…DI3: Free<br>DI4: First PFA Relay<br>DI5: Second PFA Relay<br>DI6: Free |
| 3 | Not allowed | DI1…DI3: Free<br>DI4: First PFA Relay<br>DI5: Second PFA Relay<br>DI6: Third PFA Relay |
| 4…6 | Not allowed | Not allowed |

**Group 81: PFA**

| Code | Description | Range | Resolution | Default | S |
|---|---|---|---|---|---|

5 = DI5 – Enables the Interlock function, and assigns a digital input (starting with DI5) to the interlock signal for each PFA relay. These assignments are defined in the following table and depend on:
- The number of PFA relays (number of parameters 1401…1403 and 1410…1412) with value = 31 (PFA).
- The Autochange function status (disabled if 8118 AUTOCHNG INTERV = 0, and otherwise enabled).

| No. PFA Relays | Autochange Disabled (P 8118) | Autochange Enabled (P 8118) |
|---|---|---|
| 0 | DI1…DI4: Free<br>DI5: Speed Reg Motor<br>DI6: Free | Not allowed |
| 1 | DI1…DI4: Free<br>DI5: Speed Reg Motor<br>DI6: First PFA Relay | DI1…DI4: Free<br>DI5: First PFA Relay<br>DI6: Free |
| 2 | Not allowed | DI1…DI4: Free<br>DI5: First PFA Relay<br>DI6: Second PFA Relay |
| 3…6 | Not allowed | Not allowed |

6 = DI6 – Enables the Interlock function, and assigns digital input DI6 to the interlock signal for the speed regulated motor.
- Requires 8118 AUTOCHNG INTERV = 0.

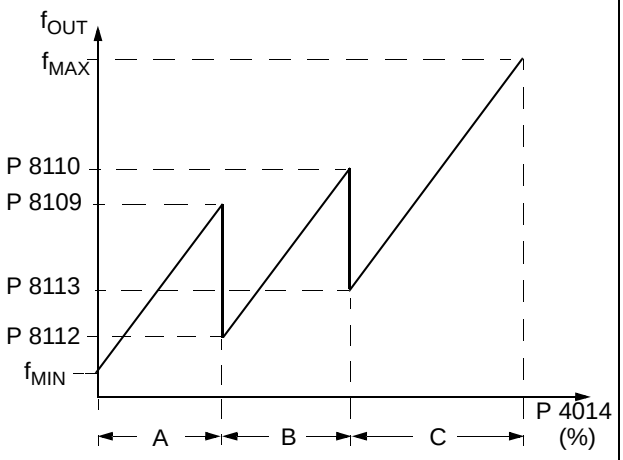
| No. PFA Relays | Autochange Disabled | Autochange Enabled |
|---|---|---|
| 0 | DI1…DI5: Free<br>DI6: Speed Reg Motor | Not allowed |
| 1 | Not allowed | DI1…DI5: Free<br>DI6: First PFA Relay |
| 2…6 | Not allowed | Not allowed |

8121 **REG BYPASS CTRL** **0…1** **1** **0**

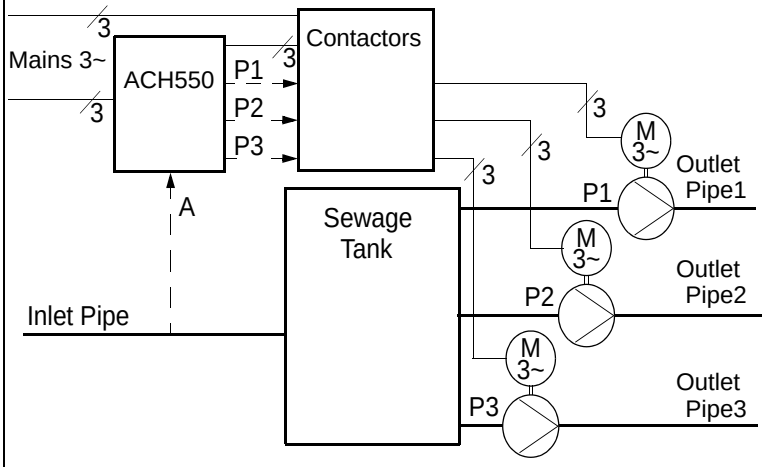
Selects Regulator by-pass control. When enabled, Regulator by-pass control provides a simple control mechanism without a PID regulator.
- Use Regulator by-pass control only in special applications.

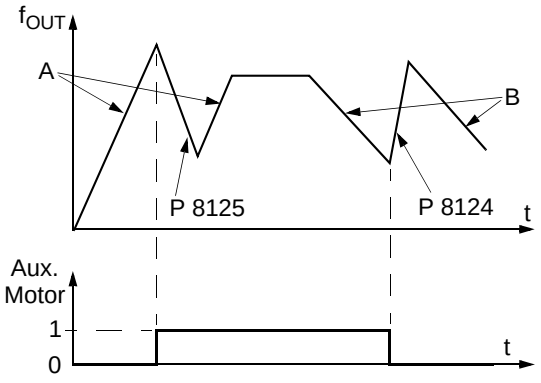
0 = NO – Disables Regulator by-pass control. The drive uses the normal PFA reference: 1106 REF2 SELECT.

1 = YES – Enables Regulator by-pass control.
- The process PID regulator is bypassed. Actual value of PID is used as the PFA reference (input). Normally EXT REF2 is used as the PFA reference.
- The drive uses the feedback signal defined by 4014 FBK SEL (or 4114) for the PFA frequency reference.
- The figure shows the relation between the control signal 4014 FBK SEL (OR 4114) and the speed regulated motor's frequency in a three-motor system.




A = No auxiliary motors running
B = One auxiliary motor running
C = Two auxiliary motors running

| Group 81: PFA | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| | Example: In the diagram below, the pumping station's outlet flow is controlled by the measured inlet flow (A).<br>  | | | | |
| 8122 | **PFA START DELAY** | **0.00…10.00 s** | **0.01 s** | **0.50 s** | |
| | Sets the start delay for speed regulated motors in the system. Using the delay, the drive works as follows:<br>• Switches on the contactor of the speed regulated motor – connecting the motor to the ACH550 power output.<br>• Delays motor start for the time 8122 PFA START DELAY.<br>• Starts the speed regulated motor.<br>• Starts auxiliary motors. See parameter 8115 for delay.<br>**Warning! Motors equipped with star-delta starters require a PFA Start Delay.**<br>• After the ACH550 relay output switches a motor On, the star-delta starter must switch to the star-connection and then back to the delta-connection before the drive applies power.<br>• So, the PFA Start Delay must be longer than the time setting of the star-delta starter. | | | | |
| 8123 | **PFA ENABLE** | **0…1** | **-** | **0** | ✓ |
| | Selects PFA control. When enabled, PFA control:<br>• Switches in, or out, auxiliary constant speed motors as output demand increases or decreases. Parameters 8109 START FREQ 1 to 8114 LOW FREQ 3 define the switch points in terms of the drive output frequency.<br>• Adjusts the speed regulated motor output down, as auxiliary motors are added, and adjusts the speed regulated motor output up, as auxiliary motors are taken off line.<br>• Provides Interlock functions, if enabled.<br>• Requires 9904 MOTOR CTRL MODE = 3 SCALAR.<br>0 = NOT SEL – Disables PFA control.<br>1 = ACTIVE – Enables PFA control. | | | | |
| 8124 | **ACC IN AUX STOP** | **0.0…1800.0 s** | **0.1 s** | **0.0** | |
| | Sets the PFA acceleration time for a zero-to-maximum frequency ramp. This PFA acceleration ramp:<br>• Applies to the speed regulated motor, when an auxiliary motor is switched off.<br>• Replaces the acceleration ramp defined in Group 22: Accel / Decel.<br>• Applies only until the output of the regulated motor increases by an amount equal to the output of the switched off auxiliary motor. Then the acceleration ramp defined in Group 22: Accel / Decel applies. | | | | |

| Group 81: PFA | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| | 0 = NOT SEL.<br>0.1…1800 = Activates this function using the value entered as the acceleration time.<br>  <br><br>• A = speed regulated motor accelerating using Group 22 parameters (2202 or 2205).<br>• B = speed regulated motor decelerating using Group 22 parameters (2203 or 2206).<br>• At aux. motor start, speed regulated motor decelerates using 8125 DEC IN AUX START.<br>• At aux. motor stop, speed regulated motor accelerates using 8124 ACC IN AUX STOP. | | | | |
| 8125 | **DEC IN AUX START** | **0.0…1800.0 s** | **0.1 s** | **0.0 s** | |
| | Sets the PFA deceleration time for a maximum-to-zero frequency ramp. This PFA deceleration ramp:<br>• Applies to the speed regulated motor, when an auxiliary motor is switched on.<br>• Replaces the deceleration ramp defined in Group 22 ACCEL / DECEL.<br>• Applies only until the output of the regulated motor decreases by an amount equal to the output of the auxiliary motor. Then the deceleration ramp defined in Group 22 ACCEL / DECEL applies.<br>0 = NOT SEL.<br>0.1…1800 = Activates this function using the value entered as the acceleration time. | | | | |
| 8126 | **TIMED AUTOCHANGE** | **0…4** | **1** | **0** | |
| | Sets the autochange with timer. When enables, autochange is controlled with the timer functions.<br>0 = NOT SEL.<br>1 = Timer 1 – Enables autochange when Timer 1 is active.<br>2…4 Timer 2…4 – Enables autochange when Timer 2…4 is active. | | | | |
| 8127 | **ACT NR OF MOT** | **0, 1, 4** | **1** | **2** | ✓ |
| | Sets the actual number of PFA controlled motors (maximum 6 motors, 1 speed regulated, 3 connected direct-on-line and 2 spare motors).<br>• This value includes also the speed regulated motor.<br>• This value must be compatible with number of relays allocated to PFA if the autochange function is used.<br>• If Autochange function is not used, the speed regulated motor does not need to have a relay output allocated to PFA but it needs to be included in this value. | | | | |

### Group 98: Options

This group configures for options, in particular, enabling serial communication with the drive.

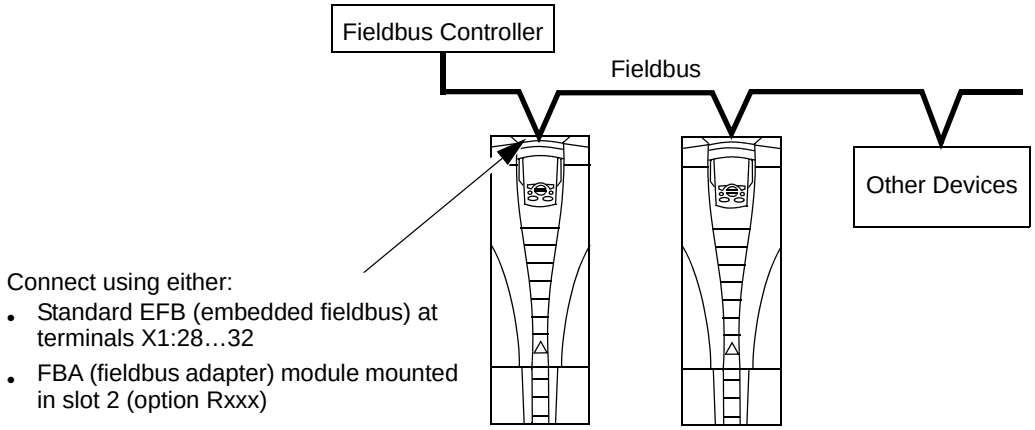
| Group 98: Options | | | | | |
|---|---|---|---|---|---|
| **Code** | **Description** | **Range** | **Resolution** | **Default** | **S** |
| 9802 | **COMM PROT SEL** | **0, 1, 4** | **1** | **0** | |
| | Selects the communication protocol.<br>0 = NOT SEL – No communication protocol selected.<br>1 = STD MODBUS – Enables fieldbus communication with the drive using Modbus protocol via the RS485 serial link (X1-communications terminal).<br>• See also parameter Group 53 EFB PROTOCOL.<br>2 = N2 – Enables fieldbus communication with the drive using Metasys N2 protocol via the RS485 serial link (X1-communications terminal).<br>3 = FLN – Enables fieldbus communication with the drive using FLN protocol via the RS485 serial link (X1-communications terminal).<br>4 = EXT FBA – The drive communicates via a fieldbus adapter module in option slot 2 of the drive.<br>• See also parameter Group 51 EXT COMM MODULE.<br>5 = BACNET – Enables fieldbus communication with the drive using BACnet protocol via the RS485 serial link (X1-communications terminal). | | | | |

# Serial Communication – EFB

## Overview

The ACH550 can be set up to accept control from an external system using standard serial communication protocols. When using serial communication, the ACH550 can either:

- Receive all of its control information from the fieldbus, or
- Be controlled from some combination of fieldbus control and other available control locations, such as digital or analog inputs, and the control panel.




Two basic serial communications configurations are available:

- EFB (embedded fieldbus) – Using the RS485 interface at terminals X1:28…32 on the control board, a control system can communicate through the drive's standard EFB using one of the following protocols (For protocol descriptions, see "Modbus Protocol Technical Data", "ABB Drives Profile Technical Data", etc. starting on page 155.):
  - Modbus®
  - Metasys® N2
  - APOGEE® FLN
  - BACnet® (Not available at the time of printing)
- FBA (fieldbus adapter) – See "Serial Communication – FBA" on page 193.

### Control Interface

In general, the basic control interface between the fieldbus system and the drive consists of:

| Protocol | Control Interface | Reference for more information |
|---|---|---|
| Modbus | • Output Words<br>– Control word<br>– Reference1<br>– Reference2<br>• Input Words<br>– Status word<br>– Actual value 1<br>– Actual value 2<br>– Actual value 3<br>– Actual value 4<br>– Actual value 5<br>– Actual value 6<br>– Actual value 7<br>– Actual value 8 | "Modbus Protocol Technical Data" and/or<br>"ABB Drives Profile Technical Data" |
| N2 | • Binary output objects<br>• Analog output objects<br>• Binary input objects<br>• Analog input objects | "N2 Protocol Technical Data" |
| FLN | • Binary output points<br>• Analog output points<br>• Binary input points<br>• Analog input points | "FLN Protocol Technical Data" |
| BACnet | TBD | "BACnet Technical Data" |

**Note!** The words “output” and “input” are used as seen from the fieldbus controller point of view. For example an output describes data flow from the fieldbus controller to the drive and appears as an input from the drive point of view.

## Planning

Network planning should address the following questions:

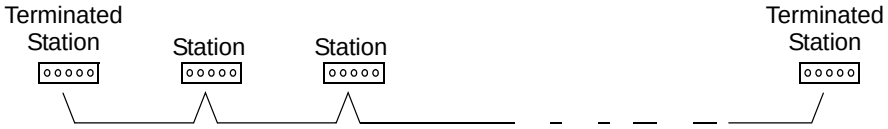
- What types and quantities of devices must be connected to the network?
- What control information must be sent down to the drives?
- What feedback information must be sent from the drives to the controlling system?

## Mechanical and Electrical Installation – EFB

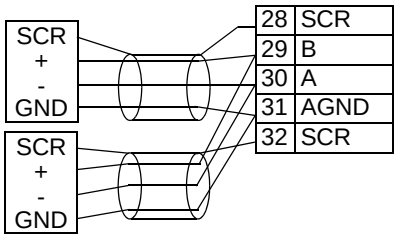
**Warning! Connections should be made only while the drive is disconnected from the power source.**

Drive terminals 28...32 are for RS485 communications.

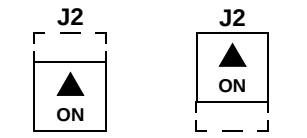
- Use Belden 9842 or equivalent. Belden 9842 is a dual twisted, shielded pair cable with a wave impedance of 120 Ω.
- Use one of these twisted shielded pairs for the RS485 link. Use this pair to connect all A (-) terminals together and all B (+) terminals together.
- Use one of the wires in the other pair for the logical ground (terminal 31), leaving one wire unused.
- Do not directly ground the RS485 network at any point. Ground all devices on the network using their corresponding earthing terminals.
- As always, the grounding wires should not form any closed loops, and all the devices should be earthed to a common ground.
- Connect the RS485 link in a daisy-chained bus, without dropout lines.
- To reduce noise on the network, terminate the RS485 network using 120 Ω resistors at both ends of the network. Use the DIP switch to connect or disconnect the termination resistors. See following diagram and table.




| X1 | Identification | Hardware Description |
|---|---|---|
| 28 | Screen | RS485 Multidrop application |
| 29 | B (Positive +) | |
| 30 | A (Negative -) | |
| 31 | AGND | |
| 32 | Screen | |




**RS485 interface**




OFF position ON position
Bus termination

- Connect the shield at each end of the cable to a drive. On one end, connect the shield to terminal 28, and on the other end connect to terminal 32. Do not connect the incoming and outgoing cable shields to the same terminals, as that would make the shielding continuous.
- For configuration information see the following:
  - "Communication Set-up – EFB" below.
  - "Activate Drive Control Functions – EFB" on page 147.
  - The appropriate EFB protocol specific technical data. For example, "Modbus Protocol Technical Data" on page 155.

# Communication Set-up – EFB

## Serial Communication Selection

To activate the serial communication, set parameter 9802 COMM PROTOCOL SEL =

- 1 (STD MODBUS).
- 2 (N2)
- 3 (FLN)
- 5 (BACNET)

---

**Note!** If you cannot see the desired selection on the panel, your drive does not have that protocol software in the application memory.

---

## Serial Communication Configuration

Setting 9802 automatically sets the appropriate default values in parameters that define the communication process. These parameters and descriptions are defined below. In particular, note that the station Id may require adjustment.

| Code | Description | EFB Protocol Reference | | | |
|---|---|---|---|---|---|
| | | **Modbus** | **N2** | **FLN** | **BACnet** |
| 5301 | EFB PROTOCOL ID<br>Contains the identification and program revision of the protocol. | Do not edit. Any non-zero value entered for parameter 9802 COMM PROT SEL, sets this parameter automatically. The format is: XXYY, where xx = protocol ID, and YY = program revision. | | | |
| 5302 | EFB STATION ID<br>Defines the node address of the RS485 link. | Set each drive on the network with a unique value for this parameter.<br>**Note:** For a new address to take affect, the drive power must be cycled **OR** 5302 must first be set to 0 before selecting a new address. Leaving 5302 = 0 places the RS485 channel in reset, disabling communication. | | | |
| 5303 | EFB BAUD RATE<br>Defines the communication speed of the RS485 link in kbits per second (kbits/s).<br>1.2 kbits/s<br>2.4 kbits/s<br>4.8 kbits/s<br>9.6 kbits/s<br>19.2 kbits/s<br>38.4 kbits/s<br>57.6 kbits/s | Setting (9.6) is default when protocol is selected. | | | Setting (4.8) is default when protocol is selected. Do not edit. |

| Code | Description | EFB Protocol Reference | | | |
|---|---|---|---|---|---|
| | | Modbus | N2 | FLN | BACnet |
| 5304 | EFB PARITY0<br>Defines the data length parity and stop bits to be used with the RS485 link communication.<br>• The same settings must be used in all on-line stations.<br>0 = 8N1 – 8 data bits, No parity, one stop bit.<br>1 = 8N2 – 8 data bits, No parity, two stop bits.<br>2 = 8E1 – 8 data bits, Even parity, one stop bit.<br>3 = 8O1 – 8 data bits, Odd parity, one stop bit. | Setting (1) is default when protocol is selected. | Setting (0) is default when protocol is selected. | | |
| 5305 | EFB CTRL PROFILE0<br>Selects the communication profile used by the EFB protocol.<br>0 = ABB DRIVES – Operation of Control Word and Status Word conforms to ABB Drives Profile.<br>1 = ACS550 – Alternate 32 bit profile (Advanced users only). | Setting (0) is default when protocol is selected. | N/A. Setting (0) is default when protocol is selected. | | |

**Note!** After any changes to the communication settings, protocol must be reactivated by either cycling the drive power, or by clearing and then restoring the station Id (5302).

## Activate Drive Control Functions – EFB

### Controlling the Drive

Fieldbus control of various drive functions requires configuration to:

- Tell the drive to accept fieldbus control of the function.
- Define as a fieldbus input, any drive data required for control.
- Define as a fieldbus output, any control data required by the drive.

The following sections describe, at a general level, the configuration required for each control function. For the protocol-specific details, see the document supplied with the FBA module.

### Start/Stop Direction Control

Using the fieldbus for start/stop/direction control of the drive requires:

- Drive parameter values set as defined below.

- Fieldbus controller supplied command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent – the table shows samples.)

| Drive Parameter | | Value | Description | Protocol Reference | | | |
|---|---|---|---|---|---|---|---|
| | | | | Modbus[1] | N2 | FLN | BACnet[2] |
| 1001 | EXT1 COMMANDS | 10 (COMM) | Start/Stop by fieldbus with Ext1 selected. | 40001 bit 3 | BO1 | 24 | |
| 1002 | EXT2 COMMANDS | 10 (COMM) | Start/Stop by fieldbus with Ext2 selected. | 40001 bit 3 | BO1 | 24 | |
| 1003 | DIRECTION | 3 (REQUEST) | Direction by fieldbus. | Note 3 | BO2 | 22 | |

1. Applies only for Modbus using ABB Drive profile.
2. BACnet not defined at time of publication.
3. The reference provides direction control – a negative reference provides reverse rotation.

### Input Reference Select

Using the fieldbus to provide input references to the drive requires:

- Drive parameter values set as defined below.
- Fieldbus controller supplied reference word(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent – the table shows samples.)

| Drive Parameter | | Value | Setting | Protocol Reference | | | |
|---|---|---|---|---|---|---|---|
| | | | | Modbus[1] | N2 | FLN | BACnet[2] |
| 1102 | EXT1/EXT2 SEL | 8 (COMM) | Reference set selection by fieldbus. | 40001 bit 11 | BO5 | 26 | |
| 1103 | REF1 SEL | 8 (COMM) | Input reference 1 by fieldbus. | 40002 | AO1 | 60 | |
| 1106 | REF2 SEL | 8 (COMM) | Input reference 2 by fieldbus. | 40003 | AO2 | 61 | |

1. Applies only for Modbus using ABB Drive profile.
2. BACnet not defined at time of publication.

*Reference Scaling*

Where required, REFERENCES can be scaled. See the following, as appropriate:

- Modbus Register "40002" in the "Modbus Protocol Technical Data" section.
- "Reference Scaling" in the "ABB Drives Profile Technical Data" section.
- "N2 Analog Output Objects" in the "N2 Protocol Technical Data" section.
- The slope of points 60 and 61 in the "FLN Protocol Technical Data" section.
- TBD in the "BACnet Technical Data" section.

### Miscellaneous Drive Control

Using the fieldbus for miscellaneous drive control requires:

- Drive parameter values set as defined below.
- Fieldbus controller supplied command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent – the table shows samples.)

| Drive Parameter | | Value | Setting | Protocol Reference | | | |
|---|---|---|---|---|---|---|---|
| | | | | Modbus[1] | N2 | FLN | BACnet[2] |
| 1601 | RUN ENABLE | 7 (COMM) | Run enable by fieldbus. | 40001 bit 3 | BO4 | 35 | |
| 1604 | FAULT RESET SEL | 8 (COMM) | Fault reset by fieldbus. | 40001 bit 7 | BO6 | 94 | |
| 1607 | PARAM SAVE | 1 (SAVE) | Saves altered parameters to memory (then value returns to 0). | 41607 | BO18 | N/A[3] | |

1. Applies only for Modbus using ABB Drive profile.
2. BACnet not defined at time of publication.
3. Use Memorize Point command.

### Relay Output Control

Using the fieldbus for relay output control requires:

- Drive parameter values set as defined below.
- Fieldbus controller supplied, binary coded, relay command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

| Drive Parameter | | Value | Setting | Protocol Reference | | | |
|---|---|---|---|---|---|---|---|
| | | | | Modbus[2] | N2 | FLN | BACnet[3] |
| 1401 | RELAY OUTPUT 1 | 35 (COMM) | Relay Output 1 controlled by fieldbus. | 40134 bit 0 or 00033 | BO7 | 40 | |
| 1402 | RELAY OUTPUT 2 | 35 (COMM) | Relay Output 2 controlled by fieldbus. | 40134 bit 1 or 00034 | BO8 | 41 | |
| 1403 | RELAY OUTPUT 3 | 35 (COMM) | Relay Output 3 controlled by fieldbus. | 40134 bit 2 or 00035 | BO9 | 42 | |
| 1410[1] | RELAY OUTPUT 4 | 35 (COMM) | Relay Output 4 controlled by fieldbus. | 40134 bit 3 or 00036 | BO10 | 43 | |
| 1411[1] | RELAY OUTPUT 5 | 35 (COMM) | Relay Output 5 controlled by fieldbus. | 40134 bit 4 or 00037 | BO11 | 44 | |
| 1412[1] | RELAY OUTPUT 6 | 35 (COMM) | Relay Output 6 controlled by fieldbus. | 40134 bit 5 or 00038 | BO12 | 45 | |

1. More than 3 relays requires the addition of a relay extension module.
2. Applies only for Modbus using ABB Drive profile.
3. BACnet not defined at time of publication.

**For example:** To control relays 1 and 2 using serial communication:
Set parameters 1401 RELAY OUTPUT 1 and 1402 RELAY OUTPUT 1 = 35 (COMM).

Then, for example using N2:

- To turn Relay 1 On: Force object B07 to On.
- To turn Relay 2 On: Force object B08 to On.
- To turn both Relay 1 and 2 On: Force objects B07 and B08 On.

---

**Note!** Relay status feedback occurs without configuration as defined below.

---

| Drive Parameter | | Setting | Protocol Reference | | | |
|---|---|---|---|---|---|---|
| | | | Modbus[1] | N2 | FLN | BACnet[2] |
| 0122 | RO 1-3 STATUS | Relay 1…3 status. | 40122 | BI4…BI6 | 76…78 | |
| 0123 | RO 4-6 STATUS | Relay 4…6 status. | 40123 | BI7…BI9 | 79…81 | |

1. Applies only for Modbus using ABB Drive profile.
2. BACnet not defined at time of publication.

### Analog Output Control

Using the fieldbus for analog output control (e.g. PID setpoint) requires:

- Drive parameter values set as defined below.
- Fieldbus controller supplied analog value(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

| Drive Parameter | | Value | Setting | Protocol Reference | | | |
|---|---|---|---|---|---|---|---|
| | | | | Modbus[1] | N2 | FLN | BACnet[2] |
| 1501 | AO1 CONTENT SEL | 135 (COMM VALUE 1) | Analog Output 1 controlled by writing to parameter 0135. | – | – | – | – |
| 0135 | COMM VALUE 1 | – | | 40135 | AO14 | 46 | |
| 1507 | AO2 CONTENT SEL | 136 (COMM VALUE 2) | Analog Output 2 controlled by writing to parameter 0136. | – | – | – | – |
| 0136 | COMM VALUE 2 | – | | 40136 | AO15 | 47 | |

1. Applies only for Modbus using ABB Drive profile.
2. BACnet not defined at time of publication.

### PID Control Setpoint Source

Using the fieldbus for the PID control setpoint requires:

- Drive parameter values set as defined below.

- Fieldbus controller supplied setpoint value in the appropriate location. (As defined in "Analog Output Control" above.)

| Drive Parameter | | Value | Setting | Protocol Reference | | | |
|---|---|---|---|---|---|---|---|
| | | | | Modbus | N2 | FLN | BACnet[1] |
| 4010 | SETPOINT SEL | 8 (COMM VALUE 1)<br>9 (COMM + AI1)<br>10 (COMM*AI1) | Setpoint is 0135 value (plus or times AI1) | See "Analog Output Control". | | | |

1. BACnet not defined at time of publication.

### Communication Fault

When using fieldbus control, specify the drive's action if serial communication is lost.

| Drive Parameter | | Value | Description | Protocol Reference |
|---|---|---|---|---|
| 3018 | COMM FAULT FUNC | 0 (NOT SEL)<br>1 (FAULT)<br>2 (CONST SP7)<br>3 (LAST SPEED) | Set for appropriate drive response. | – |
| 3019 | COMM FAULT TIME | Set time delay before acting on a communication loss. | | – |

## Feedback from the Drive – EFB

### Pre-defined Feedback

Inputs to the controller (drive outputs) have pre-defined meanings established by the protocol. This feedback does not require drive configuration. The following table lists a sample of feedback data. For a complete listing, see input word/point/object listings in the technical data for the appropriate protocol starting on page 155.

| Drive Parameter | | Protocol Reference | | | |
|---|---|---|---|---|---|
| | | Modbus | N2 | FLN | BACnet[1] |
| 0102 | SPEED | 40102 | AI3 | 5 | |
| 0103 | FREQ OUTPUT | 40103 | AI1 | 2 | |
| 0104 | CURRENT | 40104 | AI4 | 6 | |
| 0105 | TORQUE | 40105 | AI5 | 7 | |
| 0106 | POWER | 40106 | AI6 | 8 | |
| 0107 | DC BUS VOLT | 40107 | AI11 | 13 | |
| 0109 | OUTPUT VOLTAGE | 40109 | AI12 | 14 | |
| 0301 | FB STATUS WORD – bit 0 (STOP) | 40301 bit 0 | BI1 | 23 | |
| 0301 | FB STATUS WORD – bit 2 (REV) | 40301 bit 2 | BI2 | 21 | |
| 0118 | DI1-3 STATUS – bit 1 (DI3) | 40118 | BI12 | 72 | |

1. BACnet not defined at time of publication.

**Note!** With Modbus, any parameter can be accessed using the format: 4 followed by the parameter number.

### Mailbox Read/Write

The ACH550 provides a "Mailbox" function to access parameters that have not been pre-defined by the protocol. Using mailbox, any drive parameter can be identified and read. Mailbox can also be used to adjust parameter settings by writing a value to any parameter identified. The following table describes the use of this function.

| Name | Description | Protocol Reference | | | |
|---|---|---|---|---|---|
| | | Modbus[1] | N2 | FLN | BACnet[1] |
| Mailbox Parameter | Enter the number of the drive parameter to access. | Does not apply. | AO19 | 95 | |
| Mailbox Data | Contains the parameter value after a read, or enter the desired parameter value for a write. | | AO20 | 96 | |
| Mailbox Read | A binary value triggers a read – the value of the "Mailbox Parameter" appears in "Mailbox data". | | BO19 | 97 | |
| Mailbox Write | A binary value triggers a write – the drive value for the "Mailbox Parameter" changes to the value in "Mailbox data". | | BO20 | 98 | |

1. As noted above, Modbus provides direct access to all parameters using the format: 4 followed by the parameter number.
2. BACnet not defined at time of publication.

### Actual Value Scaling

The scaling of actual values can be protocol dependent. In general, for Actual Values, scale the feedback integer using the parameter's resolution. (See "Parameter Descriptions" section for parameter resolutions.) For example:

| Feedback Integer | Parameter Resolution | (Feedback Integer) * (Parameter Resolution) = Scaled Value |
|---|---|---|
| 1 | 0.1 mA | 1 * 0.1 mA = 0.1 mA |
| 10 | 0.1% | 10 * 0.1% = 1% |

Where parameters are in percent, the "Parameter Descriptions" section specifies what parameter corresponds to 100%. In such cases, to convert from percent to engineering units, multiply by the value of the parameter that defines 100% and divide by 100%. For example:

| Feedback Integer | Parameter Resolution | Value of the Parameter that defines 100% | (Feedback Integer) * (Parameter Resolution) * (Value of 100% Ref.) / 100% = Scaled Value |
|---|---|---|---|
| 10 | 0.1% | 1500 rpm[1] | 10 * 0.1% * 1500 RPM / 100% = 15 rpm |
| 100 | 0.1% | 500 Hz[2] | 100 * 0.1% * 500 Hz / 100% = 50 Hz |

1. Assuming, for the sake of this example, that the Actual Value uses parameter 9908 MOT NOM SPEED as the 100% reference, and that 9908 = 1500 rpm.
2. Assuming, for the sake of this example, that the Actual Value uses parameter 9907 MOT NOM FREQ as the 100% reference, and that 9907 = 500 Hz.

Although Actual Value scaling could differ from the above for the N2, FLN and BACnet protocols, it currently does not. To confirm, see the following sections, as appropriate:

- "N2 Analog Input Objects" in the "N2 Protocol Technical Data" section.
- "Scaling Drive Feedback Values" in the "FLN Protocol Technical Data" section.
- TBD in the "BACnet Technical Data" section.

## Diagnostics – EFB

### Fault Queue for Drive Diagnostics

For general ACH550 diagnostics information, see "Diagnostics" starting on page 212. The three most recent ACH550 faults are reported to the fieldbus as defined below.

| Drive Parameter | | Protocol Reference | | | |
|---|---|---|---|---|---|
| | | Modbus | N2 | FLN | BACnet[1] |
| 0401 | Last Fault | 40401 | 17 | 90 | |
| 0412 | Previous Fault 1 | 40402 | 18 | 91 | |
| 0413 | Previous Fault 2 | 40403 | 19 | 92 | |

1. Applies only for Modbus using ABB Drive profile.
2. BACnet not defined at time of publication.

### Serial Communication Diagnostics

Network problems can be caused by multiple sources. Some of these sources are:

- Loose connections
- Incorrect wiring (including swapped wires)
- Bad grounding
- Duplicate station numbers
- Incorrect setup of drives or other devices on the network

The major diagnostic features for fault tracing on an EFB network include Group 53 EFB Protocol parameters 5306…5309. The "Parameter Descriptions" section describes these parameters in detail.

### Diagnostic Situations

The sub-sections below describe various diagnostic situations – the problem symptoms and corrective actions.

*Normal Operation*

During normal network operation, 5306…5309 parameter values act as follows at each drive:

- 5306 EFB OK MESSAGES advances (advances for each message properly received and addressed to this drive).
- 5307 EFB CRC ERRORS does not advance at all (advances when an invalid message CRC is received).

- 5308 EFB UART ERRORS does not advance at all (advances when character format errors are detected, such as parity or framing errors).
- 5309 EFB status value varies depending on network traffic.

*Loss of Communication*

The ACH550 behavior, if communication is lost, was configured earlier in "Communication Fault". The parameters are 3018 COMM FAULT FUNC and 3019 COMM FAULT TIME. The "Parameter Descriptions" section describes these parameters in detail.

*No Master Station on Line*

If no master station is on line: Neither the EFB OK MESSAGES nor the errors (5307 EFB CRC ERRORS and 5308 EFB UART ERRORS) increase on any of the stations.

To correct:

- Check that a network master is connected and properly programmed on the network.
- Verify that the cable is connected, and is not cut or short circuited.

*Duplicate Stations*

If two or more stations have duplicate numbers:

- Two or more drives cannot be addressed.
- Every time there is a read or write to one particular station, the value for 5307 EFB CRC ERRORS or 5308 EFB UART ERRORS advances.

To correct: Verify the station numbers of all stations. Change conflicting station numbers.

*Swapped Wires*

If the communication wires are swapped (terminal A on one drive is connected to terminal B on another):

- The value of 5306 EFB OK MESSAGES does not advance.
- The values of 5307 EFB CRC ERRORS and 5308 EFB UART ERRORS are advancing.

To correct: Check that the RS-485 lines are not swapped.

*Fault 28 – Serial 1 Err*

If the drive's control panel shows fault code 28 "SERIAL 1 ERR", check for either of the following:

- The master system is down. To correct, resolve problem with master system.
- The communication connection is bad. To correct, check communication connection at the drive.
- The time-out selection for the drive is too short for the given installation. The master is not polling the drive within the specified time-out delay. To correct, increase the time set by parameter 3019 COMM FAULT TIME.

*Faults 31…33 – EFB1…EFB3*

The three EFB fault codes listed for the drive in "Diagnostics" starting on page 212 (fault codes 31…33) are not used.

*Intermittent Off-line Occurrences*

The problems described above are the most common problems encountered with ACH550 serial communication. Intermittent problems might also be caused by:

- marginally loose connections,
- wear on wires caused by equipment vibrations,
- insufficient grounding and shielding on both the devices and on the communication cables.

## Modbus Protocol Technical Data

### Overview

The Modbus® protocol was introduced by Modicon, Inc. for use in control environments featuring Modicon programmable controllers. Due to its ease of use and implementation, this common PLC language was quickly adopted as a de-facto standard for integration of a wide variety of master controllers and slave devices.

Modbus is a serial, asynchronous protocol. Transactions are half-duplex, featuring a single Master controlling one or more Slaves. While RS232 can be used for point-to-point communication between a single Master and a single Slave, a more common implementation features a multi-drop RS485 network with a single Master controlling multiple Slaves. The ACH550 features RS485 for its Modbus physical interface.

*RTU*

The Modbus specification defines two distinct transmission modes: ASCII and RTU. The ACH550 supports RTU only.

*Feature Summary*

The following Modbus function codes are supported by the ACH550.

| Function | Code (Hex) | Description |
|---|---|---|
| Read Coil Status | 0x01 | Read discrete output status. For the ACH550, the individual bits of the control word are mapped to Coils 1…16. Relay outputs are mapped sequentially beginning with Coil 33 (e.g. RO1=Coil 33). |
| Read Discrete Input Status | 0x02 | Read discrete inputs status. For the ACH550, the individual bits of the status word are mapped to Inputs 1…16 or 1…32, depending on the active profile. Terminal inputs are mapped sequentially beginning with Input 33 (e.g. DI1=Input 33). |
| Read Multiple Holding Registers | 0x03 | Read multiple holding registers. For the ACH550, the entire parameter set is mapped as holding registers, as well as command, status and reference values. |
| Read Multiple Input Registers | 0x04 | Read multiple input registers. For the ACH550, the 2 analog input channels are mapped as input registers 1 & 2. |
| Force Single Coil | 0x05 | Write a single discrete output. For the ACH550, the individual bits of the control word are mapped to Coils 1…16. Relay outputs are mapped sequentially beginning with Coil 33 (e.g. RO1=Coil 33). |

| Function | Code (Hex) | Description |
|---|---|---|
| Write Single Holding Register | 0x06 | Write single holding register. For the ACH550, the entire parameter set is mapped as holding registers, as well as command, status and reference values. |
| Diagnostics | 0x08 | Perform Modbus diagnostics. Subcodes for Query (0x00), Restart (0x01) & Listen Only (0x04) are supported. |
| Force Multiple Coils | 0x0F | Write multiple discrete outputs. For the ACH550, the individual bits of the control word are mapped to Coils 1…16. Relay outputs are mapped sequentially beginning with Coil 33 (e.g. RO1=Coil 33). |
| Write Multiple Holding Registers | 0x10 | Write multiple holding registers. For the ACH550, the entire parameter set is mapped as holding registers, as well as command, status and reference values. |
| Read/Write Multiple Holding Registers | 0x17 | This function combines functions 0x03 and 0x10 into a single command. |

*Mapping Summary*

The following table summarizes the mapping between the ACH550 (parameters and I/0) and Modbus reference space. For details, see "Modbus Addressing" below.

| ACH550 | Modbus Reference | Supported Function Codes |
|---|---|---|
| • Control Bits<br>• Relay Outputs | Coils(0xxxx) | • 01 – Read Coil Status<br>• 05 – Force Single Coil<br>• 15 – Force Multiple Coils |
| • Status Bits<br>• Discrete Inputs | Discrete Inputs(1xxxx) | • 02 – Read Input Status |
| • Analog Inputs | Input Registers(3xxxxx) | • 04 – Read Input Registers |
| • Parameters<br>• Control/Status Words<br>• References | Holding Registers(4xxxx) | • 03 – Read 4X Registers<br>• 06 – Preset Single 4X Register<br>• 16 – Preset Multiple 4X Registers<br>• 23 – Read/Write 4X Registers |

*Communication Profiles*

When communicating by Modbus, the ACH550 supports multiple profiles for control and status information. Parameter 5305 (EFB CTRL PROFILE) selects the profile used.

- ABB DRIVES (Standard) – The primary (and default) profile is the ABB Drives Profile, which standardizes the control interface among ABB drives. This profile is based on the PROFIBUS interface, and is discussed in detail in the following sections.
- ACH550 (Alternate) – An alternate profile is called the ACH550 Profile. It extends the control and status interface to 32 bits, and is the internal interface between the main drive application and the embedded fieldbus environment. This profile is intended for advanced users only. This manual does not cover the ACH550 Profile in detail. Contact your ABB supplier if you need more information on this profile.

### Modbus Addressing

With Modbus, each function code implies access to a specific Modbus reference set. Thus, the leading digit is not included in the address field of a Modbus message.

---

**Note:** The ACH550 supports the zero-based addressing of the Modbus specification. Holding register 40002 is addressed as 0001 in a Modbus message. Similarly, coil 33 is addressed as 0032 in a Modbus message.

---

Refer again to the "Mapping Summary" above. The following sections describe, in detail, the mapping to each Modbus reference set.

**0xxxx Mapping – Modbus Coils.** The drive maps the following information to the 0xxxx Modbus set called Modbus Coils:

- Bit-wise map of the CONTROL WORD (selected using parameter 5305 EFB CTRL PROFILE). The first 32 coils are reserved for this purpose.
- Relay output states, numbered sequentially beginning with coil 00033.

The following table summarizes the 0xxxx reference set:

| Modbus Ref. | ACH550 | | |
|---|---|---|---|
| | Internal Location (All Profiles) | Standard Profile (ABB DRIVES) 5305 EFB CTRL PROFILE = 0 | Alternate Profile (ACH550) 5305 EFB CTRL PROFILE = 1 |
| **0**0001 | CONTROL WORD – Bit 0 | OFF1* | STOP |
| **0**0002 | CONTROL WORD – Bit 1 | OFF2* | START |
| **0**0003 | CONTROL WORD – Bit 2 | OFF3* | REVERSE |
| **0**0004 | CONTROL WORD – Bit 3 | START | LOCAL |
| **0**0005 | CONTROL WORD – Bit 4 | N/A | RESET |
| **0**0006 | CONTROL WORD – Bit 5 | RAMP_HOLD* | EXT2 |
| **0**0007 | CONTROL WORD – Bit 6 | RAMP_IN_ZERO* | RUN_DISABLE |
| **0**0008 | CONTROL WORD – Bit 7 | RESET | STPMODE_R |
| **0**0009 | CONTROL WORD – Bit 8 | N/A | STPMODE_EM |
| **0**0010 | CONTROL WORD – Bit 9 | N/A | STPMODE_C |
| **0**0011 | CONTROL WORD – Bit 10 | N/A | RAMP_2 |
| **0**0012 | CONTROL WORD – Bit 11 | EXT2 | RAMP_OUT_0 |
| **0**0013 | CONTROL WORD – Bit 12 | N/A | RAMP_HOLD |
| **0**0014 | CONTROL WORD – Bit 13 | N/A | RAMP_IN_0 |
| **0**0015 | CONTROL WORD – Bit 14 | N/A | REQ_LOCALLOCK |
| **0**0016 | CONTROL WORD – Bit 15 | N/A | TORQLIM2 |
| **0**0017… **0**0032 | Reserved | Reserved | Reserved |
| **0**0033 | Relay Output 1 | Relay Output 1 | Relay Output 1 |
| **0**0034 | Relay Output 2 | Relay Output 2 | Relay Output 2 |
| **0**0035 | Relay Output 3 | Relay Output 3 | Relay Output 3 |
| **0**0036 | Relay Output 4 | Relay Output 4 | Relay Output 4 |

| Modbus Ref. | ACH550 | | |
|---|---|---|---|
| | Internal Location (All Profiles) | Standard Profile (ABB DRIVES) 5305 EFB CTRL PROFILE = 0 | Alternate Profile (ACH550) 5305 EFB CTRL PROFILE = 1 |
| **0**0037 | Relay Output 5 | Relay Output 5 | Relay Output 5 |
| **0**0038 | Relay Output 6 | Relay Output 6 | Relay Output 6 |

* = Active low

For the 0xxxx registers:

- Status is always readable.
- Forcing is allowed by user configuration of the drive for fieldbus control.
- Additional relay outputs are added sequentially.

The ACH550 supports the following Modbus function codes for coils:

| Function Code | Description |
|---|---|
| 01 | Read coil status |
| 05 | Force single coil |
| 15 (0x0F Hex) | Force multiple coils |

**1xxxx Mapping – Modbus Discrete Inputs.** The drive maps the following information to the 1xxxx Modbus set called Modbus Discrete Inputs:

- Bit-wise map of the STATUS WORD (selected using parameter 5305 EFB CTRL PROFILE). The first 32 inputs are reserved for this purpose.
- Discrete hardware inputs, numbered sequentially beginning with input 33.

The following table summarizes the 1xxxx reference set:

| Modbus Ref. | ACH550 | | |
|---|---|---|---|
| | Internal Location (All Profiles) | Standard Profile (ABB DRIVES) 5305 EFB CTRL PROFILE = 0 | Alternate Profile (ACH550) 5305 EFB CTRL PROFILE = 1 |
| **1**0001 | STATUS WORD – Bit 0 | RDY_ON | READY |
| **1**0002 | STATUS WORD – Bit 1 | RDY_RUN | ENABLED |
| **1**0003 | STATUS WORD – Bit 2 | RDY_REF | STARTED |
| **1**0004 | STATUS WORD – Bit 3 | TRIPPED | RUNNING |
| **1**0005 | STATUS WORD – Bit 4 | OFF_2_STA* | ZERO_SPEED |
| **1**0006 | STATUS WORD – Bit 5 | OFF_3_STA* | ACCELERATE |
| **1**0007 | STATUS WORD – Bit 6 | SWC_ON_INHIB | DECELERATE |
| **1**0008 | STATUS WORD – Bit 7 | ALARM | AT_SETPOINT |
| **1**0009 | STATUS WORD – Bit 8 | AT_SETPOINT | LIMIT |
| **1**0010 | STATUS WORD – Bit 9 | REMOTE | SUPERVISION |
| **1**0011 | STATUS WORD – Bit 10 | ABOVE_LIMIT | REV_REF |
| **1**0012 | STATUS WORD – Bit 11 | EXT2 | REV_ACT |
| **1**0013 | STATUS WORD – Bit 12 | RUN_ENABLE | PANEL_LOCAL |
| **1**0014 | STATUS WORD – Bit 13 | N/A | FIELDBUS_LOCAL |
| **1**0015 | STATUS WORD – Bit 14 | N/A | EXT2_ACT |

| Modbus Ref. | ACH550 | | |
|---|---|---|---|
| | Internal Location (All Profiles) | Standard Profile (ABB DRIVES) 5305 EFB CTRL PROFILE = 0 | Alternate Profile (ACH550) 5305 EFB CTRL PROFILE = 1 |
| 10016 | STATUS WORD – Bit 15 | N/A | FAULT |
| 10017 | STATUS WORD – Bit 16 | Reserved | ALARM |
| 10018 | STATUS WORD – Bit 17 | Reserved | REQ_MAINT |
| 10019 | STATUS WORD – Bit 18 | Reserved | DIRLOCK |
| 10020 | STATUS WORD – Bit 19 | Reserved | LOCALLOCK |
| 10021 | STATUS WORD – Bit 20 | Reserved | CTL_MODE |
| 10022 | STATUS WORD – Bit 21 | Reserved | Reserved |
| 10023 | STATUS WORD – Bit 22 | Reserved | Reserved |
| 10024 | STATUS WORD – Bit 23 | Reserved | Reserved |
| 10025 | STATUS WORD – Bit 24 | Reserved | Reserved |
| 10026 | STATUS WORD – Bit 25 | Reserved | Reserved |
| 10027 | STATUS WORD – Bit 26 | Reserved | REQ_CTL |
| 10028 | STATUS WORD – Bit 27 | Reserved | REQ_REF1 |
| 10029 | STATUS WORD – Bit 28 | Reserved | REQ_REF2 |
| 10030 | STATUS WORD – Bit 29 | Reserved | REQ_REF2EXT |
| 10031 | STATUS WORD – Bit 30 | Reserved | ACK_STARTINH |
| 10032 | STATUS WORD – Bit 31 | Reserved | ACK_OFF_ILCK |
| 10033 | DI1 | DI1 | DI1 |
| 10034 | DI2 | DI2 | DI2 |
| 10035 | DI3 | DI3 | DI3 |
| 10036 | DI4 | DI4 | DI4 |
| 10037 | DI5 | DI5 | DI5 |
| 10038 | DI6 | DI6 | DI6 |

* = Active low

For the 1xxxx registers:

- Additional discrete inputs are added sequentially.

The ACH550 supports the following Modbus function codes for discrete inputs:

| Function Code | Description |
|---|---|
| 02 | Read input status |

**3xxxx Mapping – Modbus Inputs.** The drive maps the following information to the 3xxxx Modbus addresses called Modbus input registers:

- Any user defined analog inputs.

The following table summarizes the input registers:

| Modbus Reference | ACH550 All Profiles | Remarks |
|---|---|---|
| 30001 | AI1 | This register shall report the level of Analog Input 1 (0…100%). |

| Modbus Reference | ACH550 All Profiles | Remarks |
|---|---|---|
| **3**0002 | AI2 | This register shall report the level of Analog Input 2 (0…100%). |

The ACH550 supports the following Modbus function codes for 3xxxx registers:

| Function Code | Description |
|---|---|
| 04 | Read 3xxxx input status |

**4xxxx Register Mapping.** The drive maps its parameters and other data to the 4xxxx holding registers as follows:

- 40001…40099 map to drive control and actual values. These registers are described in the table below.
- 40101…49999 map to drive parameters 0101…9999. Register addresses that do not correspond to drive parameters are invalid. If there is an attempt to read or write outside the parameter addresses, the Modbus interface returns an exception code to the controller.

The following table summarizes the 4xxxx drive control registers 40001…40099 (for 4xxxx registers above 40099, see the drive parameter list, e.g. 40102 is parameter 0102):

| Modbus Register | ACH550 Standard Profile (ABB DRIVES) | Access | Remarks |
|---|---|---|---|
| **4**0001 | CONTROL WORD | R/W | Supported only if the drive is configured to use the ABB Drives Profile (5305 = 0). |
| **4**0002 | Reference 1 | R/W | Range = 0…+20000 (scaled to 0…1105 REF1 MAX), or -20000…0 (scaled to 1105 REF1 MAX…0). |
| **4**0003 | Reference 2 | R/W | Range = 0…+10000 (scaled to 0…1108 REF2 MAX), or -10000…0 (scaled to 1108 REF2 MAX…0). |
| **4**0004 | STATUS WORD | R | This register is only supported if the drive is configured to use the ABB Drives Profile (5305 = 0). |
| **4**0005 | Actual 1 (select using 5310) | R | By default, stores a copy of 0103 OUTPUT FREQ. Use parameter 5310 to select a different actual value for this register. |
| **4**0006 | Actual 2 (select using 5311) | R | By default, stores a copy of 0104 CURRENT. Use parameter 5311 to select a different actual value for this register. |
| **4**0007 | Actual 3 (select using 5312) | R | By default, stores nothing. Use parameter 5312 to select an actual value for this register. |
| **4**0008 | Actual 4 (select by 5313) | R | By default, stores nothing. Use parameter 5313 to select an actual value for this register. |
| **4**0009 | Actual 5 (select by 5314) | R | By default, stores nothing. Use parameter 5314 to select an actual value for this register. |
| **4**0010 | Actual 6 (select by 5315) | R | By default, stores nothing. Use parameter 5315 to select an actual value for this register. |
| **4**0011 | Actual 7 (select by 5316) | R | By default, stores nothing. Use parameter 5316 to select an actual value for this register. |
| **4**0012 | Actual 8 (select by 5317) | R | By default, stores nothing. Use parameter 5317 to select an actual value for this register. |

| Modbus Register | ACH550 Standard Profile (ABB DRIVES) | Access | Remarks |
|---|---|---|---|
| **4**0031 | ACH550 CONTROL WORD LSW | R/W | Maps directly to the Least Significant Word of the ACH550 Drive Profile CONTROL WORD. See parameter 0301. |
| **4**0032 | ACH550 CONTROL WORD MSW | R | Maps directly to the Most Significant Word of the ACH550 Drive Profile CONTROL WORD. See parameter 0302. |
| **4**0033 | ACH550 STATUS WORD LSW | R | Maps directly to the Least Significant Word of the ACH550 Drive Profile STATUS WORD. See parameter 0303. |
| **4**0034 | ACH550 STATUS WORD MSW | R | Maps directly to the Most Significant Word of the ACH550 Drive Profile STATUS WORD. See parameter 0304. |

For the Modbus protocol, drive parameters in group 53 report the parameter mapping to 4xxxx Registers.

| Code | Description |
|---|---|
| 5310 | EFB PAR 10<br>Specifies the parameter mapped to Modbus register 40005. |
| 5311 | EFB PAR 11<br>Specifies the parameter mapped to Modbus register 40006. |
| 5312 | EFB PAR 12<br>Specifies the parameter mapped to Modbus register 40007. |
| 5313 | EFB PAR 13<br>Specifies the parameter mapped to Modbus register 40008. |
| 5314 | EFB PAR 14<br>Specifies the parameter mapped to Modbus register 40009. |
| 5315 | EFB PAR 15<br>Specifies the parameter mapped to Modbus register 40010. |
| 5316 | EFB PAR 16<br>Specifies the parameter mapped to Modbus register 40011. |
| 5317 | EFB PAR 17<br>Specifies the parameter mapped to Modbus register 40012. |
| 5318<br>…<br>5320 | EFB PAR 18…20<br>Reserved |

Except where restricted by the drive, all parameters are available for both reading and writing. The parameter writes are verified for the correct value, and for a valid register addresses.

---

**Note!** Parameter writes through standard Modbus are always volatile i.e. modified values are not automatically stored to permanent memory. Use parameter 1607 PARAM. SAVE to save all altered values.

---

The ACH550 supports the following Modbus function codes for 4xxxx registers:

| Function Code | Description |
|---|---|
| 03 | Read holding 4xxxx registers |
| 06 | Preset single 4xxxx register |
| 16 (0x10 Hex) | Preset multiple 4xxxx registers |
| 23 (0x17 Hex) | Read/write 4xxxx registers |

*Actual Values*

The contents of the register addresses 40005…40012 are ACTUAL VALUES and are:

- Specified using parameters 5310…5317.
- Read-only values containing information on the operation of the drive.
- 16-bit words containing a sign bit and a 15-bit integer.
- When negative values, written as the two's complement of the corresponding positive value.
- Scaled as described earlier in "Actual Value Scaling".

*Exception Codes*

Exception codes are serial communication responses from the drive. The ACH550 supports the standard Modbus exception codes defined below.

| Exception Code | Name | Meaning |
|---|---|---|
| 01 | ILLEGAL FUNCTION | Unsupported Command |
| 02 | ILLEGAL DATA ADDRESS | The data address received in the query is not allowable. It is not a defined parameter/group. |
| 03 | ILLEGAL DATA VALUE | A value contained in the query data field is not an allowable value for the ACH550, because it is one of the following:<br>• Outside min. or max. limits.<br>• Parameter is read-only.<br>• Message is too long.<br>• Parameter write not allowed when start is active.<br>• Parameter write not allowed when factory macro is selected. |

## ABB Drives Profile Technical Data

### Overview

The ABB Drives profile provides a standard profile that can be used on multiple protocols, including Modbus and the protocols available on the FBA module.

### Control Word

The CONTROL WORD is the principal means for controlling the drive from a fieldbus system. The fieldbus master station sends the CONTROL WORD to the drive. The drive switches between states according to the bit-coded instructions in the CONTROL WORD. Using the CONTROL WORD (ABB Drives profile version) requires that:

- The drive is in remote (REM) control.
- The serial communication channel is defined as the source for controlling commands (set using parameters 1001 EXT1 COMMANDS, 1002 EXT2 COMMANDS and 1102 EXT1/EXT2 SEL).
- The serial communication channel used is configured to use the ABB Drive profile. Either of the following:
  - Parameter 9802 COMM PROT SEL = 1 (STD MODBUS), and parameter 5305 EFB CTRL PROFILE = 0 (ABB DRIVES)
  - FBA module installed, parameter 9802 COMM PROT SEL = 4 (EXT FBA), and parameters 5102…5126 configured for the ABB Drives profile.

The following table and the state diagram later in this sub-section describe the CONTROL WORD content.

| ABB Drives Profile (EFB) CONTROL WORD | | | | |
|---|---|---|---|---|
| **Bit** | **Name** | **Value** | **Commanded State** | **Comments** |
| 0 | OFF1 CONTROL | 1 | READY TO OPERATE | Enter READY TO OPERATE |
| | | 0 | EMERGENCY OFF | Drive ramps to stop according to currently active deceleration ramp (2203 or 2205)<br>Normal command sequence:<br>• Enter OFF1 ACTIVE<br>• Proceed to READY TO SWITCH ON, unless other interlocks (OFF2, OFF3) are active. |
| 1 | OFF2 CONTROL | 1 | OPERATING | Continue operation (OFF2 inactive) |
| | | 0 | EMERGENCY OFF | Drive coasts to stop.<br>Normal command sequence:<br>• Enter OFF2 ACTIVE<br>• Proceed to SWITCHON INHIBITED |
| 2 | OFF3 CONTROL | 1 | OPERATING | Continue operation (OFF3 inactive) |
| | | 0 | EMERGENCY STOP | Drive stops within in time specified by parameter 2208.<br>Normal command sequence:<br>• Enter OFF3 ACTIVE<br>• Proceed to SWITCH ON INHIBITED<br>**WARNING! Be sure motor and driven equipment can be stopped using this mode.** |
| 3 | INHIBIT OPERATION | 1 | OPERATION ENABLED | Enter OPERATION ENABLED (Note the Run enable signal must be active. See 1601. If 1601 is set to COMM, this bit also actives the Run Enable signal.) |
| | | 0 | OPERATION INHIBITED | Inhibit operation. Enter OPERATION INHIBITED |
| 4 | Unused. | | | |

| ABB Drives Profile (EFB) CONTROL WORD | | | | |
|---|---|---|---|---|
| **Bit** | **Name** | **Value** | **Commanded State** | **Comments** |
| 5 | RAMP_HOLD | 1 | RFG OUT ENABLED | Enable ramp function.<br>Enter RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED |
| | | 0 | RFG OUT HOLD | Halt ramping (Ramp Function Generator output held) |
| 6 | RAMP_IN_ ZERO | 1 | RFG INPUT ENABLED | Normal operation. Enter OPERATING |
| | | 0 | RFG INPUT ZERO | Force Ramp Function Generator input to zero. |
| 7 | RESET | 0=>1 | RESET | Fault reset if an active fault exists (Enter SWITCH-ON INHIBITED). Effective if 1604 = COMM. |
| | | 0 | OPERATING | Continue normal operation |
| 8…10 | Unused | | | |
| 11 | EXT CTRL LOC | 1 | EXT2 SELECT | Select external control location 2 (EXT2). Effective if 1102 = COMM. |
| | | 0 | EXT1 SELECT | Select external control location 1 (EXT1). Effective if 1102 = COMM. |
| 12…15 | Unused | | | |

### Status Word

The contents of the STATUS WORD is status information, sent by the drive to the master station. The following table and the state diagram later in this sub-section describe the status word content.

| ABB Drives Profile (EFB) STATUS WORD | | | |
|---|---|---|---|
| **Bit** | **Name** | **Value** | **Description (Correspond to states/boxes in the state diagram)** |
| 0 | RDY_ON | 1 | READY TO SWITCH ON |
| | | 0 | NOT READY TO SWITCH ON |
| 1 | RDY_RUN | 1 | READY TO OPERATE |
| | | 0 | OFF1 ACTIVE |
| 2 | RDY_REF | 1 | OPERATION ENABLED |
| | | 0 | OPERATION INHIBITED |
| 3 | TRIPPED | 0…1 | FAULT |
| | | 0 | No fault |
| 4 | OFF_2_STA | 1 | OFF2 INACTIVE |
| | | 0 | **OFF2 ACTIVE** |
| 5 | OFF_3_STA | 1 | OFF3 INACTIVE |
| | | 0 | **OFF3 ACTIVE** |
| 6 | SWC_ON_INHIB | 1 | SWITCH-ON INHIBIT ACTIVE |
| | | 0 | SWITCH-ON INHIBIT NOT ACTIVE |

| ABB Drives Profile (EFB) STATUS WORD | | | |
|---|---|---|---|
| **Bit** | **Name** | **Value** | **Description (Correspond to states/boxes in the state diagram)** |
| 7 | ALARM | 1 | Warning/alarm (See "Alarm Listing" in the "Diagnostics" section for details on alarms.) |
| | | 0 | No warning/alarm |
| 8 | AT_SETPOINT | 1 | OPERATING. Actual value equals (within tolerance limits) the reference value. |
| | | 0 | Actual value is outside tolerance limits (not equal to reference value). |
| 9 | REMOTE | 1 | Drive control location: REMOTE (EXT1 or EXT2) |
| | | 0 | Drive control location: LOCAL |
| 10 | ABOVE_LIMIT | 1 | Supervised parameter's value ≥ supervision high limit.<br>Bit remains "1" until supervised parameter's value < supervision low limit.<br>See group 32, Supervision |
| | | 0 | Supervised parameter's value < supervision low limit.<br>Bit remains "0" until supervised parameter's value > supervision high limit.<br>See group 32, Supervision |
| 11 | EXT CTRL LOC | 1 | External control location 2 (EXT2) selected |
| | | 0 | External control location 1 (EXT1) selected |
| 12 | EXT RUN ENABLE | 1 | External Run Enable signal received |
| | | 0 | No External Run Enable signal received |
| 13… 15 | Unused | | |

**Note!** Operation of CONTROL WORD and STATUS WORD conform to the ABB Drives Profile with one exception: CONTROL WORD bit 10 (REMOTE_CMD) is not used by the ACH550.

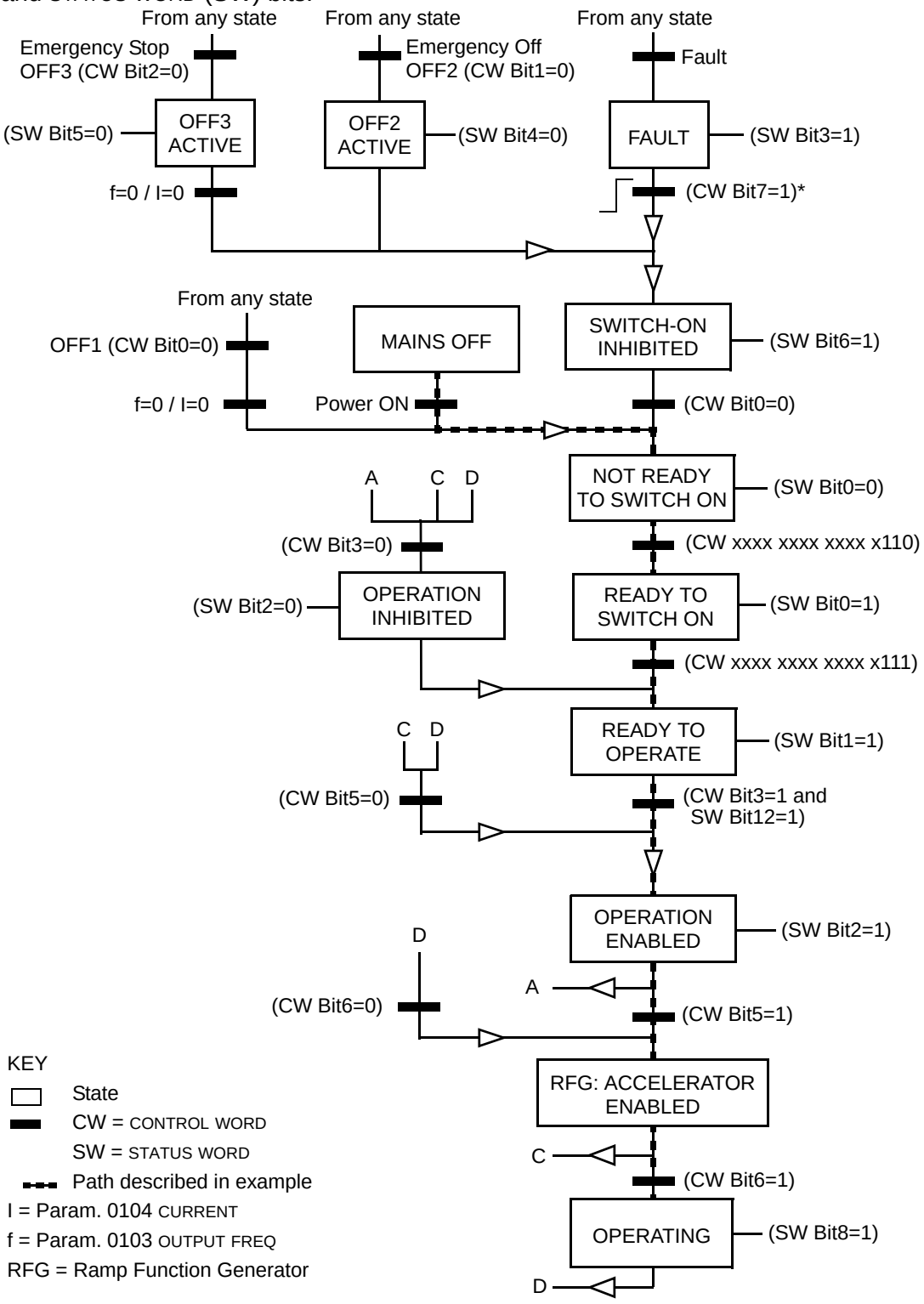
**Example.** Using the CONTROL WORD to start the drive:

- First, the requirements for using the CONTROL WORD must be met. See above.
- When the power is first connected, the state of the drive is not ready to switch on. See dotted lined path ( ▪▪▪ ) in the state diagram below.
- Use the CONTROL WORD to step through the state machine states until the OPERATING state is reached, meaning that the drive is running and follows the given reference. See table below.

| **Step** | CONTROL WORD **Value** | **Description** |
|---|---|---|
| 1 | CW = 0000 0000 0000 0110<br>bit 15 bit 0 | This CW value changes the drive state to READY TO SWITCH ON. |
| 2 | | Wait at least 100 ms before proceeding. |
| 3 | CW = 0000 0000 0000 0111 | This CW value changes the drive state to READY TO OPERATE. |
| 4 | CW = 0000 0000 0000 1111 | This CW value changes the drive state to OPERATION ENABLED. The drive starts, but will not accelerate. |

| Step | CONTROL WORD Value | Description |
|---|---|---|
| 5 | CW = 0000 0000 0010 1111 | This CW value releases the ramp function generator (RFG) output, and changes the drive state to RFG: ACCELERATOR ENABLED. |
| 6 | CW = 0000 0000 0110 1111 | This CW value releases the ramp function generator (RFG) output, and changes the drive state to OPERATING. The drive accelerates to the given reference and follows the reference. |

The state diagram below describes the start-stop function of CONTROL WORD (CW) and STATUS WORD (SW) bits.




*This state transition also occurs if the fault is reset from any other source (e.g. digital input).

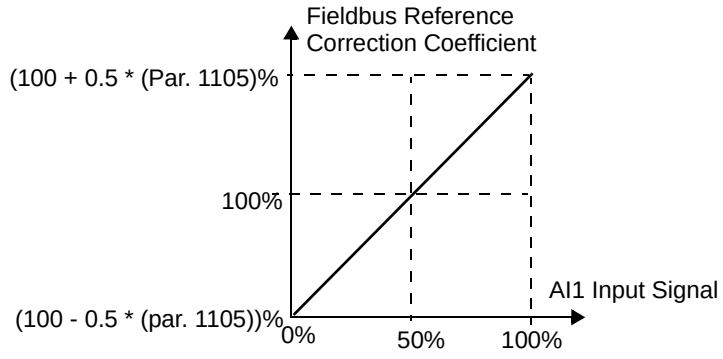
### Reference Scaling

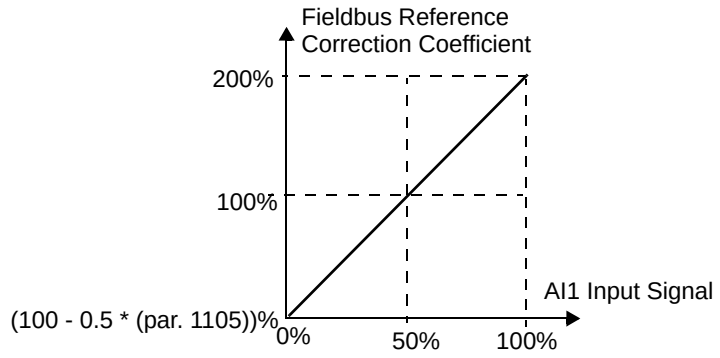
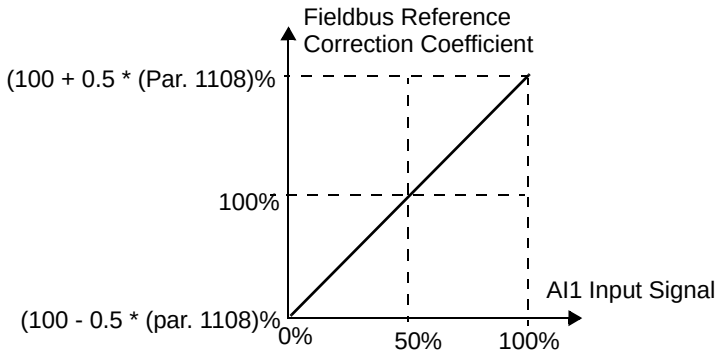
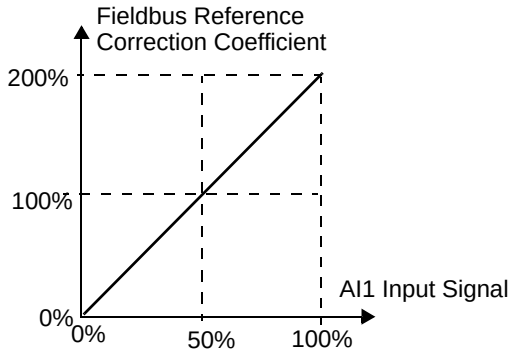
The following table describes REFERENCE scaling for the ABB Drives profile.

| ABB Drives Profile | | | | |
|---|---|---|---|---|
| **Reference** | **Range** | **Reference Type** | **Scaling** | **Remarks** |
| REF1 | -32767<br>…<br>+32767 | Speed or frequency | -20000 = -**(par. 1105)**<br>0 = 0<br>+20000 = **(par. 1105)**<br>(20000 corresponds to 100%) | Final reference limited by 1104/1105. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency). |
| REF2 | -32767<br>…<br>+32767 | Speed or frequency | -10000 = -**(par. 1108)**<br>0 = 0<br>+10000 = **(par. 1108)**<br>(10000 corresponds to 100%) | Final reference limited by 1107/1108. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency). |
| | | Torque | -10000 = -**(par. 1108)**<br>0 = 0<br>+10000 = **(par. 1108)**<br>(10000 corresponds to 100%) | Final reference limited by 2015/2017 (torque1) or 2016/2018 (torque2). |
| | | PID Reference | -10000 = -**(par. 1108)**<br>0 = 0<br>+10000 = **(par. 1108)**<br>(10000 corresponds to 100%) | Final reference limited by 4012/4013 (PID set1) or 4112/4113 (PID set2). |

**Note!** The setting of parameter 1104 REF1 MIN and 1107 REF2 MIN has no effect on the scaling of references.

When parameter 1103 REF1 SELECT or 1106 REF2 SELECT is set to COMM+AI1 or COMM*AI1, the reference is scaled as follows:

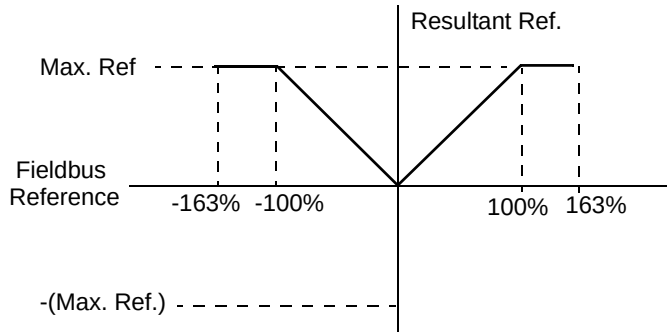
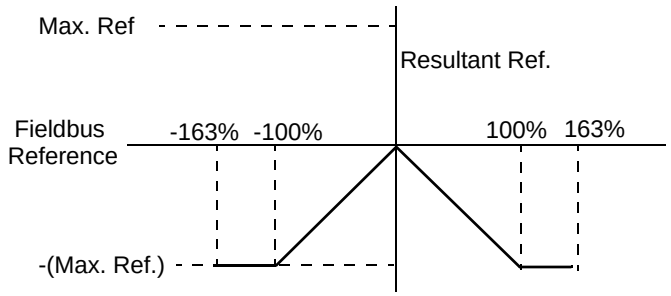
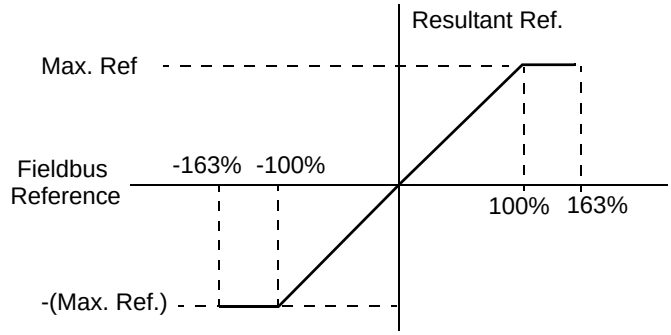
| ABB Drives Profile | | |
|---|---|---|
| **Reference** | **Value Setting** | **AI Reference Scaling** |
| REF1 | COMM+AI1 | COMM (%) +(AI (%) - 0.5*REF1 MAX (%))<br>  <br> |

| ABB Drives Profile | | |
|---|---|---|
| **Reference** | **Value Setting** | **AI Reference Scaling** |
| REF1 | COMM*AI1 | COMM (%) * (AI (%) / 0.5*REF1 MAX (%))<br>  <br> |
| REF2 | COMM+AI1 | COMM (%) + (AI (%) - 0.5*REF2 MAX (%))<br>  <br> |
| REF2 | COMM*AI1 | COMM (%) * (AI (%) / 0.5*REF2 MAX (%))<br>  <br> |

*Reference Handling*

Use group 10 parameters to configure for control of rotation direction for each control location (EXT1 and EXT2). The following diagrams illustrate how group 10 parameters and the sign of the fieldbus reference interact to produce REFERENCE values (REF1

and REF2). Note, fieldbus references are bipolar, that is they can be positive or negative.

| ABB Drives Profile | | |
|---|---|---|
| **Parameter** | **Value Setting** | **AI Reference Scaling** |
| 1003 DIRECTION | 1 (FORWARD) |  |
| 1003 DIRECTION | 2 (REVERSE) |  |
| 1003 DIRECTION | 3 (REQUEST) |  |

## N2 Protocol Technical Data

### Overview

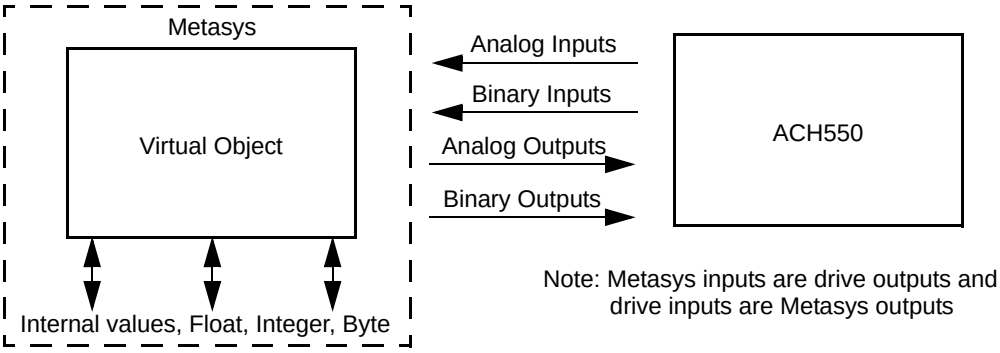
The N2 Fieldbus connection to the ACH550 drives is based on an industry standard RS-485 physical interface. The N2 Fieldbus protocol is a master-slave type, serial communication protocol, used by the Johnson Controls Metasys® system. In the Metasys architecture the N2 Fieldbus connects object interfaces and remote controllers to Network Control Units (NCUs).

The N2 Fieldbus can also be used to connect ACH550 drives to the Metasys Companion product line.

This section describes the use of the N2 Fieldbus with the ACH550 drives' connection and does not describe the protocol in detail.

*Supported Features*

In the N2 Fieldbus protocol the ACH550 drive appears as a "virtual object".




A virtual object is made up of:

- Analog Inputs
- Binary Inputs
- Analog Outputs
- Binary Outputs
- Internal values for Floating point, Integer, and Byte values.

The ACH550 drive does not support N2 Fieldbus communication "internal values".

All of the Analog and Binary I/O objects are listed below, starting with "N2 Analog Input Objects" on page 173.

**Analog Input** – The analog input objects support the following features:

- Analog Input actual value in engineering units
- Low Alarm limit
- Low Warning limit
- High Warning limit
- High Alarm limit
- Differential value for the hysteresis of the Alarms and Warnings
- Change of State (COS) enabled
- Alarm Enabled
- Warning Enabled
- Override value is received, but there is no action taken.

**Binary Input** – The binary input objects support the following features:

- Binary Input actual value
- Normal / Alarm state specification
- Alarm Enabled
- Change of State (COS) enabled

- Override value is received, but there is no action taken.

**Analog Output** – The analog output objects support the following features:

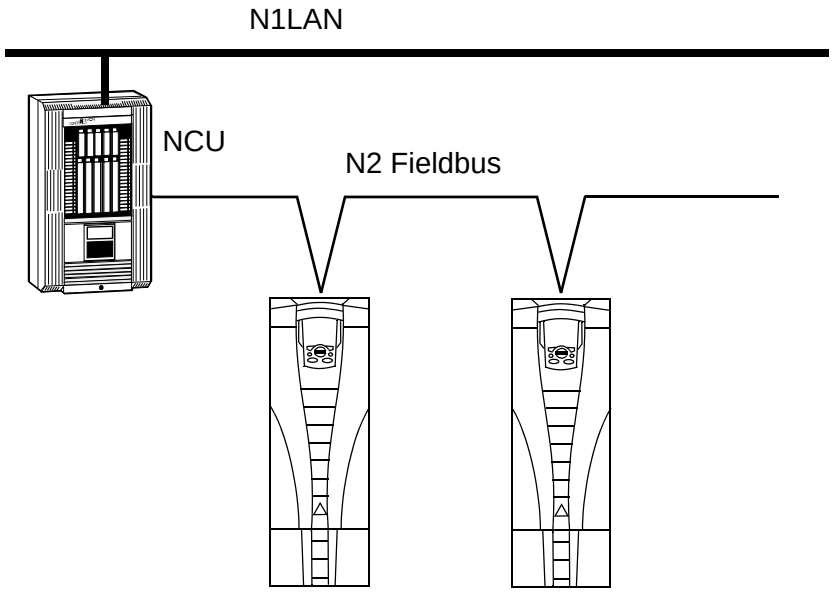
- Analog Output value in engineering units
- Override value is used to change the Analog Output value. It is not possible to return to the previous value by removing the override. The override feature is used only to change the value.

**Binary Output** – The binary output objects support the following features:

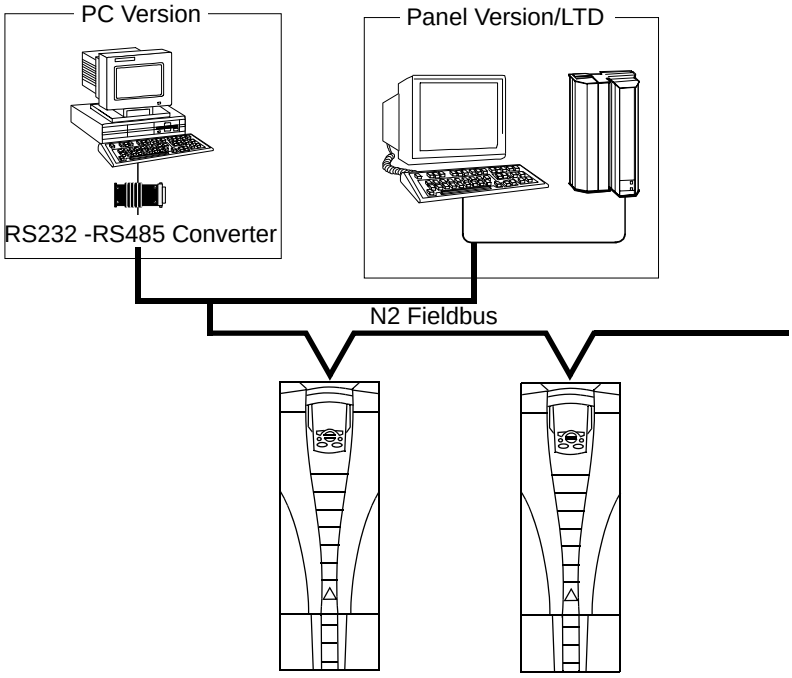
- Binary Output value
- Override value is used to change the Binary Output value. It is not possible to return to the previous value by removing the override. The override feature is used only to change the value.

*Metasys Integration*

The following diagram shows the drives' integration to the Johnson Controls Metasys system.



The following diagram shows the drives' integration to the Johnson Controls Metasys Companion system.




On the N2 Fieldbus each ACH550 drive can be accessed by the full complement of Metasys FMS features, including Change-of-State (COS) monitoring, alarm notification, scheduling, trend, and totalization.

On one N2 Fieldbus segment there can be up to 32 nodes while integrating ACH550 drives with Johnson Controls Metasys.

*Drive Device Type*

For the Metasys and Metasys Companion products, the device type for the ACH550 drive is VND.

### N2 Analog Input Objects

The following table lists all of the N2 Analog Input objects defined for the ACH550 drive.

| N2 Analog Inputs: | | | | | |
|---|---|---|---|---|---|
| **Number** | **Object** | **Drive Parameter** | **Scale Factor** | **Units** | **Range** |
| AI1 | OUTPUT FREQUENCY | 0103 | 10 | Hz | 0…250 |
| AI2 | RATED SPEED | Note 1 | 10 | % | 0 …100 |
| AI3 | SPEED | 0102 | 1 | rpm | 0 …9999 |
| AI4 | CURRENT | 0104 | 10 | A | 0…9999 |
| AI5 | TORQUE | 0105 | 10 | % | -200…200 |
| AI6 | POWER | 0106 | 10 | kW | 0…9999 |
| AI7 | DRIVE TEMPERATURE | 0110 | 10 | °C | 0 …125 |
| AI8 | KILOWATT HOURS | 0115 | 1 | kWh | 0…9999 |

| N2 Analog Inputs: | | | | | |
|---|---|---|---|---|---|
| **Number** | **Object** | **Drive Parameter** | **Scale Factor** | **Units** | **Range** |
| AI9 | MEGAWATT HOURS | 0141 | 1 | MWh | 0…999 |
| AI10 | RUN TIME | 0114 | 1 | H | 0…9999 |
| AI11 | DC BUS VOLTAGE | 0107 | 1 | V | 0…999 |
| AI12 | OUTPUT VOLTAGE | 0109 | 1 | V | 0…999 |
| AI13 | PRC PID FEEDBACK | 0130 | 10 | % | 0…100 |
| AI14 | PRC PID DEVIATION | 0132 | 10 | % | 0…100 |
| AI15 | EXT PID FEEDBACK | 0131 | 10 | % | 0…100 |
| AI16 | EXT PID DEVIATION | 0133 | 10 | % | 0…100 |
| AI17 | LAST FAULT | 0401 | 1 | | fault code |
| AI18 | PREV FAULT | 0402 | 1 | | fault code |
| AI19 | OLDEST FAULT | 0403 | 1 | | fault code |
| AI20 | AI 1 ACTUAL | 0120 | 10 | % | 0…100 |
| AI21 | AI 2 ACTUAL | 0121 | 10 | % | 0…100 |
| AI22 | AO 1 ACTUAL | 0124 | 10 | mA | 0…20 |
| AI23 | AO 2 ACTUAL | 0125 | 10 | mA | 0…20 |
| AI24 | MOTOR TEMP | 0145 | 1 | °C | 0…200 |
| AI25 | REVOLUTION CNT | 0142 | 1 | MREV | 0…32767 |

1. RATED SPEED is a percent of maximum frequency (parameter 2008) if the drive is in scalar mode, and is a percent of maximum speed (parameter 2002) in speed mode.

### N2 Binary Input Objects

The following table lists all of the N2 Binary Input objects defined for the ACH550 drive.

| N2 Binary Inputs: | | | |
|---|---|---|---|
| **Number** | **Object** | **Drive Parameter** | **Range** |
| BI1 | STOP/RUN | Status Word | 0 = Stop, 1 = Drive Running |
| BI2 | FORWARD/REVERSE | Status Word | 0 = Forward, 1 = Reverse |
| BI3 | FAULT STATUS | Status Word | 0 = OK, 1 = Drive Fault |
| BI4 | RELAY 1 STATUS | 0122 (bit mask 04) | 0 = Off, 1 = On |
| BI5 | RELAY 2 STATUS | 0122 (bit mask 02) | 0 = Off, 1 = On |
| BI6 | RELAY 3 STATUS | 0122 (bit mask 01) | 0 = Off, 1 = On |
| BI7 | RELAY 4 STATUS | 0123 (bit mask 04) | 0 = Off, 1 = On |
| BI8 | RELAY 5 STATUS | 0123 (bit mask 02) | 0 = Off, 1 = On |
| BI9 | RELAY 6 STATUS | 0123 (bit mask 01) | 0 = Off, 1 = On |
| BI10 | INPUT 1 STATUS | 0118 (bit mask 04) | 0 = Off, 1 = On |
| BI11 | INPUT 2 STATUS | 0118 (bit mask 02) | 0 = Off, 1 = On |
| BI12 | INPUT 3 STATUS | 0118 (bit mask 01) | 0 = Off, 1 = On |
| BI13 | INPUT 4 STATUS | 0119 (bit mask 04) | 0 = Off, 1 = On |

| N2 Binary Inputs: | | | |
|---|---|---|---|
| **Number** | **Object** | **Drive Parameter** | **Range** |
| BI14 | INPUT 5 STATUS | 0119 (bit mask 02) | 0 = Off, 1 = On |
| BI15 | INPUT 6 STATUS | 0119 (bit mask 01) | 0 = Off, 1 = On |
| BI16 | EXTERNAL 2 SELECT | Status Word | 0 = EXT1 = EXT2 |
| BI17 | HAND/AUTO | Status Word | 0 = AUTO, 1 = HAND |
| BI18 | ALARM | Status Word | 0 = OK, 1 = ALARM |
| BI19 | MAINTENANCE REQ | Status Word | 0 = OK, 1 = MAINT REQ |
| BI20 | DRIVE READY | Status Word | 0 = Not Ready, 1 = Ready |
| BI21 | AT SETPOINT | Status Word | 0 = No, 1 = At Setpoint |
| BI22 | RUN ENABLED | Status Word | 0 = Not Enabled, 1 = Enabled |
| BI23 | N2 LOCAL MODE | Status Word | 0 = Auto, 1 = N2 Local |
| BI24 | N2 CONTROL SRC | Status Word | 0 = No, 1 = Yes |
| BI25 | N2 REF1 SRC | Status Word | 0 = No, 1 = Yes |
| BI26 | N2 REF2 SRC | Status Word | 0 = No, 1 = Yes |

### N2 Analog Output Objects

The following table lists all of the N2 Analog Output objects defined for the ACH550 drive.

| N2 Analog Outputs: | | | | | |
|---|---|---|---|---|---|
| **Number** | **Object** | **Drive Parameter** | **Scale Factor** | **Units** | **Range** |
| AO1 | REFERENCE 1 | Reference 1 | 10 | % | 0…100 |
| AO2 | REFERENCE 2 | Reference 2 | 10 | % | 0…100 |
| AO3 | ACCEL TIME 1 | 2202 | 10 | s | 0.1…1800 |
| AO4 | DECEL TIME 1 | 2203 | 10 | s | 0.1…1800 |
| AO5 | CURRENT LIMIT | 2003 | 10 | A | 0…1.3*$I_{2N}$ |
| AO6 | PID1-CONT GAIN | 4001 | 10 | % | 0.1…100 |
| AO7 | PID1-CONT I-TIME | 4002 | 10 | s | 0.1…600 |
| AO8 | PID1-CONT D-TIME | 4003 | 10 | s | 0…10 |
| AO9 | PID1-CONT D FILTER | 4004 | 10 | s | 0…10 |
| AO10 | PID2-CONT GAIN | 4101 | 10 | % | 0.1…100 |
| AO11 | PID2-CONT I-TIME | 4102 | 10 | s | 0.1…600 |
| AO12 | PID2-CONT D-TIME | 4103 | 10 | s | 0…10 |
| AO13 | PID2-CONT D FILTER | 4104 | 10 | s | 0…10 |
| AO14 | COMMAND AO 1 | 135 | 10 | % | 0…100 |
| AO15 | COMMAND AO 2 | 136 | 10 | % | 0…100 |
| AO16 | EXT PID SETPOINT | 4211 | 10 | % | 0…100 |
| AO17 | SPD OUT MIN | 2001/2007 | 10 | % | 0…200 |
| AO18 | SPD OUT MAX | 2002/2008 | 10 | % | 0…200 |
| A019 | MAILBOX PARAMETER | | 1 | | 0…65535 |

| N2 Analog Outputs: | | | | | |
|---|---|---|---|---|---|
| **Number** | **Object** | **Drive Parameter** | **Scale Factor** | **Units** | **Range** |
| A020 | MAILBOX DATA | | 1 | | 0…65535 |

### N2 Binary Output Objects

The following table lists all of the N2 Binary Output objects defined for the ACH550 drive.

| N2 Binary Outputs: | | | |
|---|---|---|---|
| **Number** | **Object** | **Drive Parameter** | **Range** |
| BO1 | STOP/START | Command Word | 0 = Stop, 1 = Start to Speed |
| BO2 | FORWARD/REVERSE | Command Word | 0 = Forward, 1 = Reverse |
| BO3 | PANEL LOCK | Command Word | 0 = Open, 1 = Locked |
| BO4 | RUN ENABLE | Command Word | 0 = Enable, 1 = Disable |
| BO5 | REF1/REF2 SELECT | Command Word | 0 = Ref1, 1 = Ref2 |
| BO6 | FAULT RESET | Command Word | Change 0 -> 1 Resets |
| BO7 | COMMAND RO 1 | 134 (bit mask 01) | 0 = Off, 1 = On |
| BO8 | COMMAND RO 2 | 134 (bit mask 02) | 0 = Off, 1 = On |
| BO9 | COMMAND RO 3 | 134 (bit mask 04) | 0 = Off, 1 = On |
| BO10 | COMMAND RO 4 | 134 (bit mask 08) | 0 = Off, 1 = On |
| BO11 | COMMAND RO 5 | 134 (bit mask 10) | 0 = Off, 1 = On |
| BO12 | COMMAND RO 6 | 134 (bit mask 20) | 0 = Off, 1 = On |
| BO13 | RESET RUN TIME | 114 (indirectly) | 0 = N/A, 1 = On (Reset Run Time) |
| BO14 | RESET KWH COUNT | 115 (indirectly) | 0 = N/A, 1 = On (Reset kWh Count) |
| BO15 | PRC PID SELECT | 4027 (indirectly) | 0 = SET2, 1 = SET2 |
| BO16 | N2 LOCAL CTL (Note 1) | Command Word | 0 = Auto, 1 = N2 |
| BO17 | N2 LOCAL REF (Note 1) | Command Word | 0 = Auto, 1 = N2 |
| BO18 | SAVE PARAMETERS | 1607 (indirectly) | 0 = N/A, 1 = On (Save Parameters) |
| B019 | READ MAILBOX | | 0 = No, 1 = Yes |
| B020 | WRITE MAILBOX | | 0 = No, 1 = Yes |

1. N2 LOCAL CTL and N2 LOCAL REF have priority over drive input terminals. Use these binary outputs for temporary N2 control of the drive when COMM is not the selected control source.

### DDL File for NCU

The listing below is the Data Definition Language (DDL) file for ACH550 drives used with the Network Control Units.

This listing is useful when defining drive I/O objects to the Network Controller Units.

Below is the ACH550.DDL file listing.

```
*****************************************************************
*  ABB Drives, ACH 550 Variable Frequency Drive
*****************************************************************
```

```
CSMODEL "ACH_550","VND"

AITITLE "Analog_Inputs"
BITITLE "Binary_Inputs"
AOTITLE "Analog_Outputs"
BOTITLE "Binary_Outputs"

CSAI "AI1",N,N,"FREQ_ACT","Hz"
CSAI "AI2",N,N,"PCT_ACT","%"
CSAI "AI3",N,N,"SPEED","RPM"
CSAI "AI4",N,N,"CURRENT","A"
CSAI "AI5",N,N,"TORQUE","%"
CSAI "AI6",N,N,"POWER","kW"
CSAI "AI7",N,N,"DRV_TEMP","°C"
CSAI "AI8",N,N,"ENERGY_k","kWh"
CSAI "AI9",N,N,"ENERGY_M","MWh"
CSAI "AI10",N,N,"RUN_TIME","H"
CSAI "AI11",N,N,"DC_VOLT","V"
CSAI "AI12",N,N,"VOLT_ACT","V"
CSAI "AI13",N,N,"PID1_ACT","%"
CSAI "AI14",N,N,"PID2_DEV","%"
CSAI "AI15",N,N,"PID2_ACT","%"
CSAI "AI16",N,N,"PID2_DEV","%"
CSAI "AI17",N,N,"LAST_FLT","Code"
CSAI "AI18",N,N,"PREV_FLT","Code"
CSAI "AI19",N,N,"1ST_FLT","Code"
CSAI "AI20",N,N,"AI_1_ACT","%"
CSAI "AI21",N,N,"AI_2_ACT","%"
CSAI "AI22",N,N,"AO_1_ACT","mA"
CSAI "AI23",N,N,"AO_2_ACT","mA"
CSAI "AI24",N,N,"MTR_TEMP","°C"
CSAI "AI25",N,N,"REVL_CNT",""

CSBI "BI1",N,N,"STOP/RUN","STOP","RUN"
CSBI "BI2",N,N,"FWD/REV","FWD","REV"
CSBI "BI3",N,N,"FAULT","OK","FLT"
CSBI "BI4",N,N,"RELAY_1","OFF","ON"
CSBI "BI5",N,N,"RELAY_2","OFF","ON"
CSBI "BI6",N,N,"RELAY_3","OFF","ON"
CSBI "BI7",N,N,"RELAY_4","OFF","ON"
CSBI "BI8",N,N,"RELAY_5","OFF","ON"
CSBI "BI9",N,N,"RELAY_6","OFF","ON"
CSBI "BI10",N,N,"INPUT_1","OFF","ON"
CSBI "BI11",N,N,"INPUT_2","OFF","ON"
CSBI "BI12",N,N,"INPUT_3","OFF","ON"
CSBI "BI13",N,N,"INPUT_4","OFF","ON"
CSBI "BI14",N,N,"INPUT_5","OFF","ON"
CSBI "BI15",N,N,"INPUT_6","OFF","ON"
CSBI "BI16",N,N,"EXT1/2","EXT1","EXT2"
CSBI "BI17",N,N,"HND/AUTO","HAND","AUTO"
```

```
CSBI "BI18",N,N,"ALARM","OFF","ON"
CSBI "BI19",N,N,"MNTNCE_R","OFF","ON"
CSBI "BI20",N,N,"DRV_REDY","NO","YES"
CSBI "BI21",N,N,"AT_SETPT","NO","YES"
CSBI "BI22",N,N,"RUN_ENAB","NO","YES"
CSBI "BI23",N,N,"N2_LOC_M","AUTO","N2_L"
CSBI "BI24",N,N,"N2_CTRL","NO","YES"
CSBI "BI25",N,N,"N2_R1SRC","NO","YES"
CSBI "BI26",N,N,"N2_R2SRC","NO","YES"
CSAO "AO1",Y,Y,"REF_1","%"
CSAO "AO2",Y,Y,"REF_2","%"
CSAO "AO3",Y,Y,"ACCEL_1","s"
CSAO "AO4",Y,Y,"DECEL_1","s"
CSAO "AO5",Y,Y,"CURR_LIM","A"
CSAO "AO6",Y,Y,"PID1_GN","%"
CSAO "AO7",Y,Y,"PID1_I","s"
CSAO "AO8",Y,Y,"PID1_D","s"
CSAO "AO9",Y,Y,"PID1_FLT","s"
CSAO "AO10",Y,Y,PID2_GN","%"
CSAO "AO11",Y,Y,"PID2_I","s"
CSAO "AO12",Y,Y,"PID2_D","s"
CSAO "AO13",Y,Y,"PID2_FLT","s"
CSAO "AO14",Y,Y,"CMD_AO_1","%"
CSAO "AO15",Y,Y,"CMD_AO_2","%"
CSAO "AO16",Y,Y,"PI2_STPT","%"
CSAO "AO17",Y,Y,"MIN_SPD","%"
CSAO "AO18",Y,Y,"MAX_SPD","%"
CSAO "AO19",Y,Y,"MB_PARAM",""
CSAO "AO20",Y,Y,"MB_DATA",""
CSBO "BO1",Y,Y,"START","STOP","START"
CSBO "BO2",Y,Y,"REVERSE","FWD","REV"
CSBO "BO3",Y,Y,"PAN_LOCK","OPEN","LOCKED"
CSBO "BO4",Y,Y,"RUN_ENAB","DISABLE","ENABLE"
CSBO "BO5",Y,Y,"R1/2_SEL","EXT_1","EXT_2"
CSBO "BO6",Y,Y,"FLT_RSET","-","RESET"
CSBO "BO7",Y,Y,"CMD_RO_1","OFF","ON"
CSBO "BO8",Y,Y,"CMD_RO_2","OFF","ON"
CSBO "BO9",Y,Y,"CMD_RO_3","OFF","ON"
CSBO "BO10",Y,Y,"CMD_RO_4","OFF","ON"
CSBO "BO11",Y,Y,"CMD_RO_5","OFF","ON"
CSBO "BO12",Y,Y,"CMD_RO_6","OFF","ON"
CSBO "BO13",Y,Y,"RST_RTIM","OFF","RESET"
CSBO "BO14",Y,Y,"RST_KWH","OFF","RESET"
CSBO "BO15",Y,Y,"PID_SEL","SET1","SET2"
CSBO "BO16",Y,Y,"N2_LOC_C","AUTO","N2"
CSBO "BO17",Y,Y,"N2_LOC_R","EUTO","N2"
CSBO "BO18",Y,Y,"SAV_PRMS","OFF","SAVE"
CSBO "BO19",Y,Y,"READ_MB","NO","READ"
CSBO "BO20",Y,Y,"WRITE_MB","NO","WRITE"
```

# FLN Protocol Technical Data

## Overview

The FLN fieldbus connection to the ACH550 drives is based on an industry standard RS-485 physical interface. The FLN (Floor Level Network) Fieldbus protocol is a serial communication protocol, used by the Siemens APOGEE® system. The ACH550 interface is specified in Siemens application 2734.

*Supported Features*

The ACH550 supports all required FLN features.

## Reports

The ACH550 provides seven pre-defined reports. Using a report request generated from the FLN fieldbus controller, select one of the following sets of points. By providing views of selected points, these reports are often easier to work with than views of the full point database.

*ABB ACH550*

| FLN ABB ACH550 Report | | | |
|---|---|---|---|
| Point | | Subpoint Name | Data |
| # | Type | | |
| 01 | LAO | CTLR ADDRESS | Each host FLN application (e.g. CIS or Insight) controls both the particular data reported for each point, and the report format. |
| 02 | LAO | APPLICATION | |
| 20 | LAO | OVRD TIME | |
| 29 | LDO | DAY.NIGHT | |

*Startup*

| FLN Startup Report | | | |
|---|---|---|---|
| Point | | Subpoint Name | Data |
| # | Type | | |
| 21 | LDI | FWD.REV | Each host FLN application (e.g. CIS or Insight) controls both the particular data reported for each point, and the report format. |
| 22 | LDO | CMD FWD.REV | |
| 23 | LDI | STOP.RUN | |
| 24 | LDO | CMD STP.STRT | |
| 25 | LDI | EXT1.2 ACT | |
| 26 | LDO | EXT1.2 CMD | |
| 34 | LDI | ENA.DIS ACT | |
| 35 | LDO | ENA.DIS CMD | |
| 36 | LDI | FLN LOC ACT | |
| 60 | LAO | INPUT REF1 | |
| 61 | LAO | INPUT REF2 | |
| 68 | LDO | FLN LOC CTL | |
| 69 | LDO | FLN LOC REF | |

| FLN Startup Report | | | |
|---|---|---|---|
| Point | | Subpoint Name | Data |
| # | Type | | |
| 94 | LDO | RESET FAULT | |

*Overview*

| FLN Overview Report | | | |
|---|---|---|---|
| Point | | Subpoint Name | Data |
| # | Type | | |
| 03 | LAI | FREQ OUTPUT | Each host FLN application (e.g. CIS or Insight) controls both the particular data reported for each point, and the report format. |
| 04 | LAI | PCT OUTPUT | |
| 05 | LAI | SPEED | |
| 06 | LAI | CURRENT | |
| 07 | LAI | TORQUE | |
| 08 | LAI | POWER | |
| 09 | LAI | DRIVE TEMP | |
| 10 | LAI | DRIVE KWH | |
| 11 | LAI | DRIVE MWH | |
| 12 | LAI | RUN TIME | |
| 13 | LAI | DC BUS VOLT | |
| 14 | LAI | OUTPUT VOLT | |
| 17 | LAI | MOTOR TEMP | |
| 18 | LAI | MREV COUNTER | |
| 21 | LDI | FWD.REV | |
| 23 | LDI | STOP.RUN | |
| 25 | LDI | EXT1.2 ACT | |
| 27 | LDI | DRIVE READY | |
| 28 | LDI | AT SETPOINT | |
| 33 | LDI | HANDAUTO ACT | |
| 34 | LDI | ENA.DIS ACT | |
| 36 | LDI | FLN LOC ACT | |

*Drive I/O*

| FLN Drive I/O Report | | | |
|---|---|---|---|
| Point | | Subpoint Name | Data |
| # | Type | | |
| 40 | LDO | RO 1 COMMAND | Each host FLN application (e.g. CIS or Insight) controls both the particular data reported for each point, and the report format. |
| 41 | LDO | RO 2 COMMAND | |
| 42 | LDO | RO 3 COMMAND | |
| 43 | LDO | RO 4 COMMAND | |
| 44 | LDO | RO 5 COMMAND | |

| FLN Drive I/O Report | | | |
|---|---|---|---|
| Point | | Subpoint Name | Data |
| # | Type | | |
| 45 | LDO | RO 6 COMMAND | |
| 46 | LAO | AO 1 COMMAND | |
| 47 | LAO | AO 1 COMMAND | |
| 70 | LDI | DI 1 ACTUAL | |
| 71 | LDI | DI 2 ACTUAL | |
| 72 | LDI | DI 3 ACTUAL | |
| 73 | LDI | DI 4 ACTUAL | |
| 74 | LDI | DI 5 ACTUAL | |
| 75 | LDI | DI 6 ACTUAL | |
| 76 | LDI | RO 1 ACTUAL | |
| 77 | LDI | RO 2 ACTUAL | |
| 78 | LDI | RO 3 ACTUAL | |
| 79 | LDI | RO 4 ACTUAL | |
| 80 | LDI | RO 5 ACTUAL | |
| 81 | LDI | RO 6 ACTUAL | |

*Drive Config*

| FLN Drive Config. Report | | | |
|---|---|---|---|
| Point | | Subpoint Name | Data |
| # | Type | | |
| 30 | LAO | CURRENT LIM | Each host FLN application (e.g. CIS or Insight) controls both the particular data reported for each point, and the report format. |
| 31 | LAO | ACCEL TIME 1 | |
| 32 | LAO | DECEL TIME 1 | |
| 48 | LDO | RST RUN TIME | |
| 49 | LDO | RESET KWH | |
| 59 | LDO | LOCK PANEL | |
| 66 | LDO | SPD OUT MIN | |
| 67 | LDO | SPD OUT MAX | |
| 95 | LAO | MBOX PARAM | |
| 96 | LAO | MBOX DATA | |
| 97 | LDO | MBOX READ | |
| 98 | LDO | MBOX WRITE | |

*Process PID*

| FLN Process PID Report | | | |
|---|---|---|---|
| **Point** | | **Subpoint Name** | **Data** |
| **#** | **Type** | | |
| 15 | LAI | PRC PID FBCK | Each host FLN application (e.g. CIS or Insight) controls both the particular data reported for each point, and the report format. |
| 16 | LAI | PRC PID DEV | |
| 50 | LAO | PRC PID GAIN | |
| 51 | LAO | PRC PID ITIM | |
| 52 | LAO | PRC PID DTIM | |
| 53 | LAO | PRC PID DFIL | |
| 54 | LDO | PRC PID SEL | |
| 60 | LAO | INPUT REF1 | |
| 61 | LAO | INPUT REF2 | |
| 82 | LAI | AI 1 ACTUAL | |
| 83 | LAI | AI 2 ACTUAL | |
| 84 | LAI | AO 1 ACTUAL | |
| 85 | LAI | AI 2 ACTUAL | |

*External PID*

| FLN External PID Report | | | |
|---|---|---|---|
| **Point** | | **Subpoint Name** | **Data** |
| **#** | **Type** | | |
| 55 | LAO | EXT PID GAIN | Each host FLN application (e.g. CIS or Insight) controls both the particular data reported for each point, and the report format. |
| 56 | LAO | EXT PID ITIM | |
| 57 | LAO | EXT PID DTIM | |
| 58 | LAO | EXT PID DFIL | |
| 62 | LAO | EXT PID STPT | |
| 63 | LAI | EXT PID FBCK | |
| 64 | LAI | EXT PID DEV | |
| 82 | LAI | AI 1 ACTUAL | |
| 83 | LAI | AI 2 ACTUAL | |
| 84 | LAI | AO 1 ACTUAL | |
| 85 | LAI | AI 2 ACTUAL | |

### Scaling Drive Feedback Values

Feedback values are provided with units of percent, where 0% and 100% correspond to the range of the sensor being used to measure the control variable. These points have default units in Hz. If other units are required:

- Unbundle these points with appropriate slopes and intercepts.
- The new intercept equals the lowest value of the desired range.

- Calculate the new slope as follows:

$$\text{New Slope} = \frac{\text{(Desired Range, i.e. high - low values) x (Slope of Existing Point)}}{\text{Range of Existing Point}}$$

$$= \frac{\text{(60 Hz - 0 Hz) x (0.01)}}{\text{100\% - 0\%}} = 0.006$$

*Example* – You are controlling water temperature from a cooling tower using the ACH550 to control a fan. The temperature sensor has a range of 30 to 250 degrees Fahrenheit.

To unbundle the set point (INPUT REF 2), for commanding in degrees Fahrenheit, where 0…60 Hz is equal to 30…250° F:

New Intercept = 30 (the temperature that corresponds to 0%)

$$\text{New Slope} = \frac{\text{(Desired Range) x (Slope of Existing Point)}}{\text{Range of Existing Point}}$$

$$= \frac{\text{(250° F - 30° F) x (0.1)}}{\text{100\% - 0\%}} = 0.22$$

To unbundle the feedback (PRC PID FBCK) for monitoring in degrees Fahrenheit:

New Intercept = 30

$$\text{New Slope} = \frac{\text{(Desired Range) x (Slope of Existing Point)}}{\text{Range of Existing Point}}$$

$$= \frac{\text{(250° F - 30° F) x (0.01)}}{\text{100\% - 0\%}} = 0.022$$

### Loop Gains

PRC PID GAIN (Point 50) and PRC PID ITIM (Point 51) are PID parameters similar to the P and I gains in the APOGEE TECs. Because the ABB PI loop and the Siemens loop are structured differently, there is no a one-to-one correspondence between the gains. The following formulas allow translation from ABB gains to Siemens gains and vice versa:

- To convert from ABB PI gains to Siemens P and I gains:

$$\text{P GAIN}_{\text{Siemens}} = \text{PI GAIN}_{\text{ABB}} \times 0.0015$$

$$\text{I GAIN}_{\text{Siemens}} = \frac{\text{PI GAIN}_{\text{ABB}}}{\text{PI GAIN}_{\text{ABB}}} \times 0.0015$$

- To convert from Siemens P and I gains to ABB PI gains:

$$\text{P GAIN}_{\text{ABB}} = \text{PI GAIN}_{\text{Siemens}} \times 667$$

$$\text{I GAIN}_{\text{ABB}} = \frac{\text{PI GAIN}_{\text{Siemens}}}{\text{PI GAIN}_{\text{Siemens}}} \times 667$$

### Point Database

The following table lists the point database for FLN / ACH550 (Application 2734).

| FLN Point Database | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Point | | Subpoint Name | Factory Default | Engr. Units | Slope | Intercept | On Text | Off Text |
| # | Type | | (SI Units) | | | | | |
| 01 | LAO | CTLR ADDRESS | 99 | - | 1 | 0 | - | - |
| 02 | LAO | APPLICATION | 2734 | - | 1 | | - | - |
| {03} | LAI | FREQ OUTPUT | 0 | Hz | 0.1 | 0 | - | - |
| {04} | LAI | PCT OUTPUT | 0 | PCT | 0.1 | 0 | - | - |
| {05} | LAI | SPEED | 0 | RPM | 1 | 0 | - | - |
| {06} | LAI | CURRENT | 0 | A | 0.1 | | - | - |
| {07} | LAI | TORQUE | 0 | PCT | 0.1 | -200 | - | - |
| {08} | LAI | POWER | 0<br>(0) | HP<br>(KW) | 0.134<br>0.1 | 0<br>0 | - | - |
| {09} | LAI | DRIVE TEMP | 77<br>(25) | ° F<br>(° C) | 0.18<br>(0.1) | 32<br>0 | - | - |
| {10} | LAI | DRIVE KWH | 0 | KWH | 1 | | - | - |
| {11} | LAI | DRIVE MWH | 0 | MWH | 1 | | - | - |
| {12} | LAI | RUN TIME | 0 | HRS | 1 | | - | - |
| {13} | LAI | DC BUS VOLT | 0 | V | 1 | | - | - |
| {14} | LAI | OUTPUT VOLT | 0 | V | 1 | | - | - |
| {15} | LAI | PRC PID FBCK | 0 | PCT | 0.1 | | - | - |
| {16} | LAI | PRC PID DEV | 0 | PCT | 0.1 | | - | - |
| {17} | LAI | MOTOR TEMP | 77(25) | ° F (° C) | 1.8 (1) | 32 0 | - | - |
| {18} | LAI | MREV COUNTER | 0 | MREV | 1 | 0 | - | - |
| 20 | LAO | OVRD TIME | 1 | hrs | 1 | 0 | - | - |
| {21} | LDI | FWD.REV | FWD | - | 1 | 0 | REV | FWD |
| {22} | LDO | CMD FWD.REV | FWD | - | 1 | 0 | REV | FWD |
| {23} | LDI | STOP.RUN | STOP | - | 1 | 0 | RUN | STOP |
| {24} | LDO | CMD STP.STRT | STOP | - | 1 | 0 | RUN | STOP |
| {25} | LDI | EXT1.2 ACT | EXT1 | - | 1 | 0 | EXT2 | EXT1 |
| {26} | LDO | EXT1.2 CMD | EXT1 | - | 1 | 0 | EXT2 | EXT1 |
| {27} | LDI | DRIVE READY | NOTRDY | - | 1 | 0 | READY | NOTRDY |
| {28} | LDI | AT SETPOINT | NO | - | 1 | 0 | YES | NO |
| {29} | LDO | DAY.NIGHT | DAY | - | 1 | 0 | NIGHT | DAY |
| 30 | LAO | CURRENT LIM | 0 | A | 0.1 | 0 | - | - |
| 31 | LAO | ACCEL TIME 1 | 300 | sec | 0.1 | 0 | - | - |
| 32 | LAO | DECEL TIME 1 | 300 | sec | 0.1 | 0 | - | - |
| {33} | LDI | HANDAUTO ACT | AUTO | - | 1 | 0 | HAND | AUTO |

| FLN Point Database | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Point | | Subpoint Name | Factory Default | Engr. Units | Slope | Intercept | On Text | Off Text |
| # | Type | | (SI Units) | | | | | |
| {34} | LDI | ENA.DIS ACT | DISABL | - | 1 | 0 | ENABLE | DISABL |
| {35} | LDO | ENA.DIS CMD | DISABL | - | 1 | 0 | ENABLE | DISABL |
| {36} | LDI | FLN LOC ACT | AUTO | - | 1 | 0 | FLN | AUTO |
| {37} | LDI | CTL SRC | NO | - | 1 | 0 | YES | NO |
| {38} | LDI | FLN REF1 SRC | NO | - | 1 | 0 | YES | NO |
| {39} | LDI | FLN REF2 SRC | NO | - | 1 | 0 | YES | NO |
| {40} | LDO | RO 1 COMMAND | OFF | - | 1 | 0 | ON | OFF |
| {41} | LDO | RO 2 COMMAND | OFF | - | 1 | 0 | ON | OFF |
| {42} | LDO | RO 3 COMMAND | OFF | - | 1 | 0 | ON | OFF |
| {43} | LDO | RO 4 COMMAND | OFF | - | 1 | 0 | ON | OFF |
| {44} | LDO | RO 5 COMMAND | OFF | - | 1 | 0 | ON | OFF |
| {45} | LDO | RO 6 COMMAND | OFF | - | 1 | 0 | ON | OFF |
| {46} | LAO | AO 1 COMMAND | PCT | PCT | 0.1 | 0 | - | - |
| {47} | LAO | AO 1 COMMAND | PCT | PCT | 0.1 | 0 | - | - |
| 48 | LDO | RST RUN TIME | NO | - | 1 | 0 | RESET | NO |
| 49 | LDO | RESET KWH | NO | - | 1 | 0 | RESET | NO |
| 50 | LAO | PRC PID GAIN | 10 | PCT | 0.1 | 0 | - | - |
| 51 | LAO | PRC PID ITIM | 600 | SEC | 0.1 | 0 | - | - |
| 52 | LAO | PRC PID DTIM | 0 | SEC | 0.1 | 0 | - | - |
| 53 | LAO | PRC PID DFIL | 10 | SEC | 0.1 | 0 | - | - |
| 54 | LDO | PRC PID SEL | SET1 | - | 1 | 0 | SET2 | SET1 |
| 55 | LAO | EXT PID GAIN | 10 | PCT | 0.1 | 0 | - | - |
| 56 | LAO | EXT PID ITIM | 600 | SEC | 0.1 | 0 | - | - |
| 57 | LAO | EXT PID DTIM | 0 | SEC | 0.1 | 0 | - | - |
| 58 | LAO | EXT PID DFIL | 10 | SEC | 0.1 | 0 | - | - |
| 59 | LDO | LOCK PANEL | UNLOCK | - | 1 | 0 | LOCK | UNLOCK |
| {60} | LAO | INPUT REF1 | 0 | PCT | 0.1 | 0 | - | - |
| {61} | LAO | INPUT REF2 | 0 | PCT | 0.1 | 0 | - | - |
| {62} | LAO | EXT PID STPT | 0 | PCT | 0.1 | 0 | - | - |
| {63} | LAI | EXT PID FBCK | 0 | PCT | 0.1 | 0 | - | - |
| {64} | LAI | EXT PID DEV | 0 | PCT | 0.1 | 0 | - | - |

| FLN Point Database | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Point | | Subpoint Name | Factory Default | Engr. Units | Slope | Intercept | On Text | Off Text |
| # | Type | | (SI Units) | | | | | |
| 66 | LDO | SPD OUT MIN | 0 | PCT | 0.1 | 0 | - | - |
| 67 | LDO | SPD OUT MAX | 1000 | PCT | 0.1 | 0 | - | - |
| {68} | LDO | FLN LOC CTL | AUTO | - | 1 | 0 | FLN | AUTO |
| {69} | LDO | FLN LOC REF | AUTO | - | 1 | 0 | FLN | AUTO |
| {70} | LDI | DI 1 ACTUAL | OFF | - | 1 | 0 | ON | OFF |
| {71} | LDI | DI 2 ACTUAL | OFF | - | 1 | 0 | ON | OFF |
| {72} | LDI | DI 3 ACTUAL | OFF | - | 1 | 0 | ON | OFF |
| {73} | LDI | DI 4 ACTUAL | OFF | - | 1 | 0 | ON | OFF |
| {74} | LDI | DI 5 ACTUAL | OFF | - | 1 | 0 | ON | OFF |
| {75} | LDI | DI 6 ACTUAL | OFF | - | 1 | 0 | ON | OFF |
| {76} | LDI | RO 1 ACTUAL | OFF | - | 1 | 0 | ON | OFF |
| {77} | LDI | RO 2 ACTUAL | OFF | - | 1 | 0 | ON | OFF |
| {78} | LDI | RO 3 ACTUAL | OFF | - | 1 | 0 | ON | OFF |
| {79} | LDI | RO 4 ACTUAL | OFF | - | 1 | 0 | ON | OFF |
| {80} | LDI | RO 5 ACTUAL | OFF | - | 1 | 0 | ON | OFF |
| {81} | LDI | RO 6 ACTUAL | OFF | - | 1 | 0 | ON | OFF |
| {82} | LAI | AI 1 ACTUAL | 0 | PCT | 0.1 | 0 | - | - |
| {83} | LAI | AI 2 ACTUAL | 0 | PCT | 0.1 | 0 | - | - |
| {84} | LAI | AO 1 ACTUAL | 0 | MA | 0.1 | 0 | - | - |
| {85} | LAI | AI 2 ACTUAL | 0 | MA | 0.1 | 0 | - | - |
| {86} | LDI | OK.ALARM | OK | - | 1 | 0 | ALARM | OK |
| {87} | LDI | OK.MAINT | OK | - | 1 | 0 | MAINT | OK |
| {88} | LAI | ALARM WORD 1 | - | - | 1 | 0 | - | - |
| {89} | LAI | ALARM WORD 2 | - | - | 1 | 0 | - | - |
| {90} | LAI | LAST FAULT | - | - | 1 | 0 | - | - |
| {91} | LAI | PREV FAULT 1 | - | - | 1 | 0 | - | - |
| {92} | LAI | PREV FAULT 2 | - | - | 1 | 0 | - | - |
| {93} | LDI | OK.FAULT | OK | - | 1 | 0 | FAULT | OK |
| {94} | LDO | RESET FAULT | NO | - | 1 | 0 | RESET | NO |
| {95} | LAO | MBOX PARAM | - | - | 1 | 0 | - | - |
| {96} | LAO | MBOX DATA | - | - | 1 | 0 | - | - |
| {97} | LDO | MBOX READ | DONE | - | 1 | 0 | READ | DONE |
| {98} | LDO | MBOX WRITE | DONE | - | 1 | 0 | WRITE | DONE |
| {99} | LAO | ERROR STATUS | - | - | 1 | 0 | - | - |

a. Points not listed are not used in this application.

b. A single value in a column means that the value is the same in English units and in SI units.

c. Point numbers that appear in brackets { } may be unbundled at the field panel.

## Detailed Point Descriptions

| FLN Detailed Point Descriptions | | | |
|---|---|---|---|
| **Point** | | **Description** | **Drive Parameter** |
| 1 | CTRL ADDRESS | The FLN address of the drive. It can be set by FLN and by the panel. | 5302 |
| 2 | APPLICATION | The Application ID for FLN on the ACH550. This ID is assigned by Siemens for each unique application. It correlates directly to a particular point list approved at the time of release. Therefore, this point list shall remain fixed once approval is granted. Any changes to the point list shall require a new Application ID and re-approval by Siemens. The Application ID assigned to ACH550 is 2934. | |
| 3 | FREQ OUTPUT | The output frequency applied to the motor, in Hertz. | 0103 |
| 4 | PCT OUTPUT | The ratio of output frequency or speed to the corresponding maximum rating, depending on control mode.<br>• For scalar mode, it is the ratio of Output Frequency (parameter 0103) to Maximum Frequency (parameter 2008).<br>• For speed mode, it is the ratio Speed (parameter 0102) to Maximum Speed (2002). | None. This ratio is calculated by the FLN application. |
| 5 | SPEED | The calculated speed of the motor, in RPM. | 0102 |
| 6 | CURRENT | The measured output current. | 0104 |
| 7 | TORQUE | The calculated output torque of the motor as a percentage of nominal torque. | 0105 |
| 8 | POWER | The measured output power in KW. The FLN point definition also supports horsepower by selecting English units. | 0106 |
| | DRIVE TEMP | The measured heatsink temperature, in ° C. The FLN point definition also supports ° F by selecting English units. | 0110 |
| 10 | DRIVE KWH | The drive's cumulative power consumption in kilowatt-hours. This value may be reset by commanding FLN point 49, RESET KWH. | 0115 |
| 11 | DRIVE MWH | The drive's cumulative power consumption in megawatt hours. This value cannot be reset. | 0141 |
| 12 | RUN TIME | The drive's cumulative run time in hours. This value may be reset by commanding FLN point 48, RESET RUN TIME. | 0114 |
| 13 | DC BUS VOLT | The DC bus voltage level of the drive. | 0107 |
| 14 | OUTPUT VOLT | The AC output voltage applied to the motor. | 0109 |
| 15 | PRC PID FBCK | The Process PID feedback signal. | 0130 |
| 16 | PRC PID DEV | The deviation of the Process PID output signal from its setpoint. | 0132 |
| 17 | MOTOR TEMP | The measured motor temperature as set up in Group 35. | 0145 |
| 18 | ROTATION CNT | The motor's cumulative revolution count, in mega-revolutions. | 0142 |
| 19 | N/A | | |
| 20 | OVRD TIME | 1 of the 5 mandatory FLN points required for compatibility with Siemens control systems. It has no functionality in the drive application. | None |

| FLN Detailed Point Descriptions | | | |
|---|---|---|---|
| **Point** | | **Description** | **Drive Parameter** |
| 21 | FWD.REV ACT | Indicates the rotational direction of the motor, regardless of control source (1 = REV, 0 = FWD). | |
| 22 | FWD.REV CMD | Commanded by FLN to change the rotational direction of the drive.<br>• Parameter 1001 must be set to COMM for FLN to control the direction of the motor by EXT1.<br>• Parameter 1002 must be set to COMM for FLN to control the direction of the motor by EXT2. | |
| 23 | RUN.STOP ACT | Indicates the drive's run status, regardless of control source (1 = RUN, 0 = STOP). | |
| 24 | RUN.STOP CMD | Commanded by FLN to start the drive.<br>• Parameter 1001 must be set to COMM for FLN to control the run state of the drive by EXT1.<br>• Parameter 1002 must be set to COMM for FLN to have this control. | |
| 25 | EXT1.2 ACT | Indicates whether External 1 or External 2 is the active control source (1 = EXT2, 0 = EXT1). | |
| 26 | EXT1.2 CMD | Commanded by FLN to select External 1 or External 2 as the active control source (1 = EXT2, 0 = EXT1).<br>Parameter 1102 must be set to COMM for FLN to have this control. | |
| 27 | DRIVE READY | Indicates the drive is ready to accept a run command (1 = READY, 0 = NOTRDY). | |
| 28 | AT SETPOINT | Indicates the drive has reached its commanded setpoint (1 = YES, 0 = NO) | |
| 29 | DAY.NIGHT | 1 of the 5 mandatory FLN points required for compatibility with Siemens control systems. It has no functionality in the drive application. | None |
| 30 | CURRENT LIM | Sets the output current limit of the drive. | 2003 |
| 31 | ACCEL TIME 1 | Sets the acceleration time for Ramp 1. | 2202 |
| 32 | DECEL TIME 1 | Sets the deceleration time for Ramp 1. | 2203 |
| 33 | HANDAUTO ACT | Indicates whether the drive is in Hand or Auto control (1 = HAND, 0 = AUTO). | |
| 34 | ENA.DIS ACT | Indicates the status of the Run Enable command, regardless of its source (1 = ENABLE, 0 = DISABL). | |
| 35 | ENA.DIS CMD | Commanded by FLN to assert the Run Enable command (1 = ENABLE, 0 = DISABL).<br>Parameter 1601 must be set to COMM for FLN to have this control. | |
| 36 | FLN LOC ACT | Indicates if the drive has been placed in “FLN LOCAL” mode by commanding either point 68 (FLN LOC CTL) or point 69 (FLN LOC REF). Commanding either of these points to FLN (1) “steals” control from its normal source and places in under FLN control.<br>Note that the HAND mode of the panel has priority over FLN local control. | |

| FLN Detailed Point Descriptions | | | |
|---|---|---|---|
| **Point** | | **Description** | **Drive Parameter** |
| 37 | FLN CTL SRC | Indicates if FLN is a source for control inputs (1 = YES, 0 = NO).<br>Note that this status point is true if any of the following control inputs are from FLN: Run/Stop, Ext1/2 Select or Run Enable. | |
| 38 | FLN REF1 SRC | Indicates if FLN is the source for speed reference 1 (1 = YES, 0 = NO). | |
| 39 | FLN REF2 SRC | Indicates if FLN is the source for speed reference 2 (1 = YES, 0 = NO). | |
| 40 | RO1 COMMAND | Controls the output state of Relay 1.<br>Parameter 1401 must be set to COMM for FLN to have this control (1 = ON, 0 = OFF). | 0134, bit 0 |
| 41 | RO2 COMMAND | Controls the output state of Relay 2.<br>Parameter 1402 must be set to COMM for FLN to have this control (1 = ON, 0 = OFF). | 0134, bit 1 |
| 42 | RO3 COMMAND | Controls the output state of Relay 3.<br>Parameter 1403 must be set to COMM for FLN to have this control (1 = ON, 0 = OFF). | 0134, bit 2 |
| 43 | RO4 COMMAND | Controls the output state of Relay 4. Access to relay 4 require ACH550 option OREL.<br>Parameter 1410 must be set to COMM for FLN to have this control (1 = ON, 0 = OFF). | 0134, bit 3 |
| 44 | RO5 COMMAND | Controls the output state of Relay 5. Access to relay 5 require ACH550 option OREL.<br>Parameter 1411 must be set to COMM for FLN to have this control (1 = ON, 0 = OFF). | 0134, bit 4 |
| 45 | RO6 COMMAND | Controls the output state of Relay 6. Access to relay 6 require ACH550 option OREL.<br>Parameter 1412 must be set to COMM for FLN to have this control (1 = ON, 0 = OFF). | 0134, bit 5 |
| 46 | AO1 COMMAND | Controls Analog Output 1.<br>Parameter 1501 must be set to this value for FLN to have this control. | 0135 (COMM VALUE 1) |
| 47 | AO2 COMMAND | Controls Analog Output 2.<br>Parameter 1507 must be set to this value for FLN to have this control. | 0136 (COMM VALUE 2) |
| 48 | RESET RUN TIME | Commanded by FLN to reset the cumulative run timer (1 = RESET, 0 = NO).<br>The control input is rising-edge sensitive, so, once the command is issued, this point automatically returns to its inactive state. This "momentary" operation avoids any need for an explicit command to clear the point before a subsequent reset can be issued. | |
| 49 | RESET KWH | Commanded by FLN to reset the cumulative kilowatt-hour counter (1 = RESET, 0 = NO).<br>The control input is rising-edge sensitive, so, once the command is issued, this point automatically returns to its inactive state. This "momentary" operation avoids any need for an explicit command to clear the point before a subsequent reset can be issued. | |

| FLN Detailed Point Descriptions | | | |
|---|---|---|---|
| **Point** | | **Description** | **Drive Parameter** |
| 50 | PRC PID GAIN | Sets the proportional gain of the active Process PID set, as selected by Point 54, PRC PID SEL (1 = SET2, 0 = SET1). | 4001 (SET1)<br>4101 (SET2) |
| 51 | PRC PID ITIM | Sets the integration time of the active Process PID set, as selected by Point 54, PRC PID SEL (1 = SET2, 0 = SET1). | 4002 (SET1)<br>4102 (SET2) |
| 52 | PRC PID DTIM | Sets the derivation time of the active Process PID set, as selected by Point 54, PRC PID SEL (1 = SET2, 0 = SET1). | 4001 (SET1)<br>4101 (SET2) |
| 53 | PRC PID DFIL | Sets the time constant for the error-derivative of the active Process PID set, as selected by Point 54, PRC PID SEL (1 = SET2, 0 = SET1). | 4004 (SET1)<br>4104 (SET2) |
| 54 | PRC PID SEL | Selects the active Process PID set (1 = SET2, 0 = SET1). | 4027 |
| 55 | EXT PID GAIN | Sets the proportional gain of the External PID controller. | 4201 |
| 56 | EXT PID ITIM | Sets the integration time of the External PID controller. | 4202 |
| 57 | EXT PID DTIM | Sets the derivation time of the External PID controller. | 4203 |
| 58 | EXT PID DFIL | Sets the time constant for the error-derivative of the External PID controller. | 4204 |
| 59 | LOCK PANEL | Command by FLN to lock the panel and prevent parameter changes (1 = LOCK, 0 = UNLOCK). | 1602 |
| 60 | INPUT REF 1 | Sets Input Reference 1.<br>Parameter 1102 must be set to COMM for FLN to control this value. | |
| 61 | INPUT REF 2 | Sets Input Reference 2.<br>Parameter 1106 must be set to COMM for FLN to control this value. | |
| 62 | EXT PID STPT | The setpoint for the External PID controller.<br>The function of this point requires parameter 4210, PID Setpoint Select, to be set to 19 (Internal). | 4211 |
| 63 | EXT PID FBCK | The External PID feedback signal. | 0131 |
| 64 | EXT PID DEV | The deviation of the External PID output signal from its setpoint. | 0133 |
| 65 | N/A | | |
| 66 | SPD OUT MIN | Sets the minimum output speed of the drive as a percentage of the motor nominal rating. | 2007 (SCALAR)<br>2001 (SPEED) |
| 67 | SPD OUT MAX | Sets the maximum output speed of the drive as a percentage of the motor nominal rating. | 2008 (SCALAR)<br>2002 (SPEED) |
| 68 | FLN LOC CTL | Commanded by FLN to temporarily "steal" start/stop control of the drive from its normal source and place it under FLN control. This functionality is analogous to placing the drive in HAND mode at the panel, with the control being taken by FLN instead. HAND mode at the panel has priority over this point. Thus, this point is only effective in temporarily taking control from the digital inputs or some other internal control functionality. | |

| FLN Detailed Point Descriptions | | | |
|---|---|---|---|
| **Point** | | **Description** | **Drive Parameter** |
| 69 | FLN LOC REF | Commanded by FLN to temporarily "steal" input reference control of the drive from its normal source and place it under FLN control. This functionality is analogous to placing the drive in HAND mode at the panel, with the reference control being taken by FLN instead. HAND mode at the panel has priority over this point. Thus, this point is only effective in temporarily taking control from the analog inputs or some other internal control functionality. | |
| 70 | DI 1 ACTUAL | Indicates the status of Digital Input 1 (1 = ON, 0 = OFF). | 0118, bit 2 |
| 71 | DI 2 ACTUAL | Indicates the status of Digital Input 2 (1 = ON, 0 = OFF). | 0118, bit 1 |
| 72 | DI 3 ACTUAL | Indicates the status of Digital Input 3 (1 = ON, 0 = OFF). | 0118, bit 0 |
| 73 | DI 4 ACTUAL | Indicates the status of Digital Input 4 (1 = ON, 0 = OFF). | 0119, bit 2 |
| 74 | DI 5 ACTUAL | Indicates the status of Digital Input 5 (1 = ON, 0 = OFF). | 0119, bit 1 |
| 75 | DI 6 ACTUAL | Indicates the status of Digital Input 6 (1 = ON, 0 = OFF). | 0119, bit 0 |
| 76 | RO 1 ACTUAL | Indicates the status of Relay Output 1 (1 = ON, 0 = OFF). | 0122, bit 2 |
| 77 | RO 2 ACTUAL | Indicates the status of Relay Output 2 (1 = ON, 0 = OFF). | 0122, bit 1 |
| 78 | RO 3 ACTUAL | Indicates the status of Relay Output 3 (1 = ON, 0 = OFF). | 0122, bit 0 |
| 79 | RO 4 ACTUAL | Indicates the status of Relay Output 4 (1 = ON, 0 = OFF). | 0123, bit 2 |
| 80 | RO 5 ACTUAL | Indicates the status of Relay Output 5 (1 = ON, 0 = OFF). | 0123, bit 1 |
| 81 | RO 6 ACTUAL | Indicates the status of Relay Output 6 (1 = ON, 0 = OFF). | 0123, bit 0 |
| 82 | AI 1 ACTUAL | Indicates the input level of Analog Input 1. | 0120 |
| 83 | AI 2 ACTUAL | Indicates the input level of Analog Input 2. | 0121 |
| 84 | AO 1 ACTUAL | Indicates the output level of Analog Output 1. | 0124 |
| 85 | AO 2 ACTUAL | Indicates the output level of Analog Output 2. | 0125 |
| 86 | OK.ALARM | Indicates the current alarm state of the drive (1 = ALARM, 0 = OK). | |
| 87 | OK.MAINT | Indicates the current maintenance state of the drive (1 = MAINT, 0 = OK).<br>Maintenance triggers are configured in drive parameter Group 29. | |
| 88 | ALARM WORD1 | This point is a bit-field indicating active alarms in the drive. | 0308 |
| 89 | ALARM WORD2 | This point is a bit-field indicating active alarms in the drive. | 0309 |
| 90 | LAST FAULT | This point is first in the drive's fault log and indicates the most recent fault declared. | 0401 |
| 91 | PREV FAULT 1 | This point is second in the drive's fault log and indicates the previous fault declared. | 0412 |
| 92 | PREV FAULT 2 | This point is last in the drive's fault log and indicates the oldest fault in the log. | 0413 |
| 93 | OK.FAULT | Indicates the current fault state of the drive (1 = FAULT, 0 = OK). | |

| FLN Detailed Point Descriptions | | | |
|---|---|---|---|
| **Point** | | **Description** | **Drive Parameter** |
| 94 | RESET FAULT | Command by FLN to reset a faulted drive (1 = RESET, 0 = NO).<br>Parameter 1604 must be set to COMM for FLN to control this state.<br>The control input is rising-edge sensitive, so, once the command is issued, this point automatically returns to its inactive state. This "momentary" operation avoids any need for an explicit command to clear the point before a subsequent reset can be issued. | |
| 95 | MBOX PARAM | Sets the parameter to be used by the mailbox function. | |
| 96 | MBOX DATA | Sets or indicates the data value of the mailbox function. | |
| 97 | MBOX READ | Command by FLN to read the parameter value specified by Point 95, MBOX PARAM. The parameter value is returned in Point 96, MBOX DATA.<br>The control input is rising-edge sensitive, so, once the command is issued, this point automatically returns to its inactive state. This "momentary" operation avoids any need for an explicit command to clear the point before a subsequent reset can be issued. | |
| 98 | MBOX WRITE | Command by FLN to write the data value specified by Point 96, MBOX DATA, to the parameter value specified by Point 95, MBOX PARAM.<br>The control input is rising-edge sensitive, so, once the command is issued, this point automatically returns to its inactive state. This "momentary" operation avoids any need for an explicit command to clear the point before a subsequent reset can be issued. | |
| 99 | ERROR STATUS | 1 of the 5 mandatory FLN points required for compatibility with Siemens control systems. It has no functionality in the drive application. | None |

## BACnet Technical Data

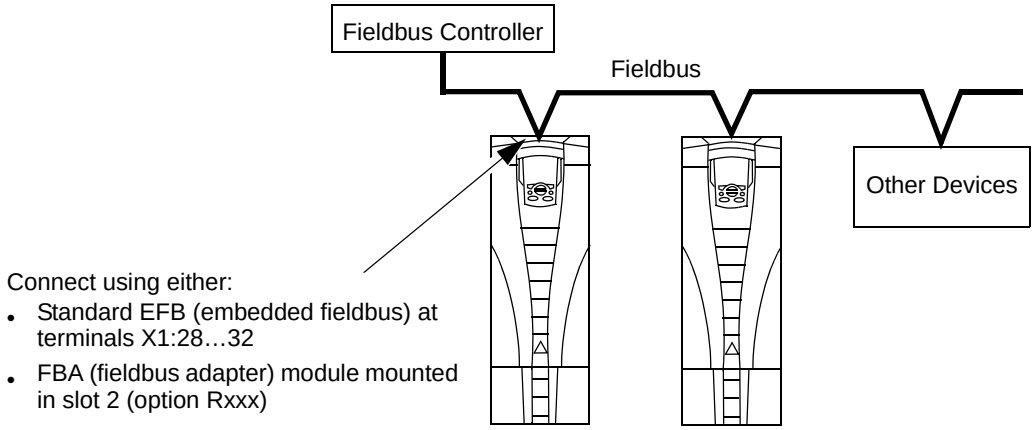
Not defined at publication.

# Serial Communication – FBA

## Overview

The ACH550 can be set up to accept control from an external system using standard serial communication protocols. When using serial communication, the ACH550 can either:

- Receive all of its control information from the fieldbus, or
- Be controlled from some combination of fieldbus control and other available control locations, such as digital or analog inputs, and the control panel.




Two basic serial communications configurations are available:

- EFB (embedded fieldbus) – See "Serial Communication – EFB" on page 143.
- FBA (fieldbus adapter) – With one of the optional FBA modules in the drive's expansion slot 2, the drive can communicate to a control system using one of the following protocols:
  - Profibus-DP®
  - LonWorks®
  - CANopen®
  - DeviceNet®
  - ControlNet®
  - Ethernet®

The ACH550 detects automatically which communication protocol is used by the plug-in fieldbus adapter. The default settings for each protocol assume that the profile used is the protocol's industry-standard drive profile (e.g. PROFIdrive for PROFIBUS, AC/DC Drive for DeviceNet). All of the FBA protocols can also be configured for the ABB Drives profile.

Configuration details depend on the protocol and profile used.These details are provided in a user's manual supplied with the FBA module.

Details for the ABB Drives profile (which apply for all protocols) are provided in "ABB Drives Profile Technical Data" on page 203.

### Control Interface

In general, the basic control interface between the fieldbus system and the drive consists of:

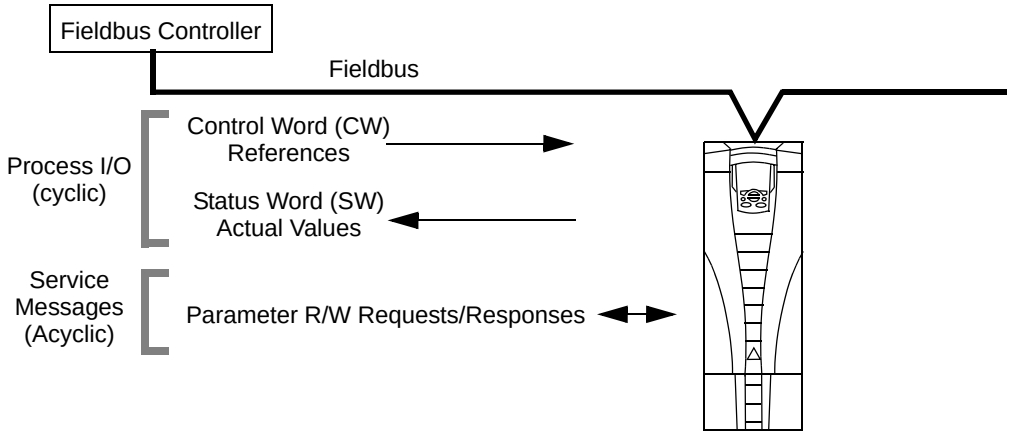
- Output Words:
  - CONTROL WORD
  - REFERENCE (speed or frequency)
  - Others: The drive supports a maximum of 15 output words. Protocols limits may further restrict the total.
- Input Words:
  - STATUS WORD
  - Actual Value (speed or frequency)
  - Others: The drive supports a maximum of 15 input words. Protocols limits may further restrict the total.

---

**Note!** The words “output” and “input” are used as seen from the fieldbus controller point of view. For example an output describes data flow from the fieldbus controller to the drive and appears as an input from the drive point of view.

---

The meanings of the controller interface words are not restricted by the ACH550. However, the profile used may set particular meanings.




*Control Word*

The CONTROL WORD is the principal means for controlling the drive from a fieldbus system. The fieldbus controller sends the CONTROL WORD to the drive. The drive switches between states according to the bit-coded instructions in the CONTROL WORD. Using the CONTROL WORD requires that:

- The drive is in remote (REM) control.

- The serial communication channel is defined as the source for controlling commands from EXT1 (set using parameters 1001 EXT1 COMMANDS and 1102 EXT1/EXT2 SEL).
- The external plug-in fieldbus adapter is activated:
  - Parameter 9802 COMM PROT SEL = 4 (EXT FBA).
  - The external plug-in fieldbus adapter is configured to use the drive profile mode or drive profile objects.

The content of the CONTROL WORD depends on the protocol/profile used. See the user's manual provided with the FBA module and/or the "ABB Drives Profile Technical Data".

*Status Word*

The STATUS WORD is a 16-bit word containing status information, sent by the drive to the fieldbus controller. The content of the STATUS WORD depends on the protocol/profile used. See the user's manual provided with the FBA module and/or the "ABB Drives Profile Technical Data" section.

*Reference*

The contents of each REFERENCE word:

- Can be used, as speed or frequency reference.
- Is a 16-bit word comprised of a sign bit and a 15-bit integer.
- Negative references (indicating reversed rotation direction) are indicated by the two's complement of the corresponding positive reference value.

The use of a second reference (REF2) is supported only when a protocol is configured for the ABB Drives profile.

Reference scaling is fieldbus type specific. See the user's manual provided with the FBA module and/or the following sections as appropriate:

- "ABB Drives Profile Technical Data"
- "Generic Profile Technical Data"

*Actual Values*

Actual Values are 16-bit words containing information on selected operations of the drive. Drive Actual Values (for example, group 01 parameters) can be mapped to Input Words using group 51 parameters (protocol-dependent, but typically parameters 5104…5126).

## Planning

Network planning should address the following questions:

- What types and quantities of devices must be connected to the network?
- What control information must be sent down to the drives?
- What feedback information must be sent from the drives to the controlling system?

# Mechanical and Electrical Installation – FBA

**Warning! Connections should be made only while the drive is disconnected from the power source.**

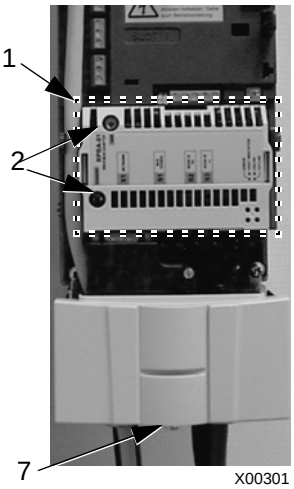
*Overview*

The FBA (fieldbus adaptor) is a plug-in module that fits in the drive's expansion slot 2. The module is held in place with plastic retaining clips and two screws. The screws also ground the shield for the module cable, and connect the module GND signals to the drive control board.

On installation of the module, electrical connection to the drive is automatically established through the 34-pin connector.

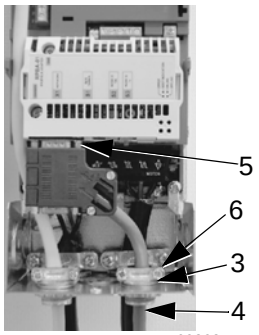
*Mounting Procedure*

**Note!** Install the input power and motor cables first.




1. Insert the module carefully into the drive expansion slot 2 until the retaining clips lock the module into position.
2. Fasten the two screws (included) to the stand-offs.

**Note!** Correct installation of the screws is essential for fulfilling the EMC requirements and for proper operation of the module.




3. Open the appropriate knockout in the conduit box and install the cable clamp for the network cable.
4. Route the network cable through the cable clamp.
5. Connect the network cable to the module's network connector.
6. Tighten the cable clamp.
7. Install the conduit box cover (1 screw).
8. For configuration information see the following:
   - "Communication Set-up – FBA" below.
   - "Activate Drive Control Functions – FBA" on page 197.
   - The protocol specific documentation provided with the module.

# Communication Set-up – FBA

### Serial Communication Selection

To activate the serial communication, use parameter 9802 COMM PROTOCOL SEL. Set 9802 = 4 (EXT FBA).

### Serial Communication Configuration

Setting 9802, together with mounting a particular FBA module, automatically sets the appropriate default values in parameters that define the communication process. These parameters and descriptions are defined in the user's manual supplied with the FBA module.

- Parameter 5101 is automatically configured.
- Parameters 5102…5126 are protocol-dependent and define, for example, the profile used, and additional I/O words. These parameters are referred to as the fieldbus configuration parameters. See the user's manual provided with the FBA module for details on the fieldbus configuration parameters.
- Parameter 5127 forces the validation of changes to parameters 5102…5126. If parameter 5127 is not used, changes to parameters 5102…5126 take affect only after the drive power is cycled.
- Parameters 5128…5133 provide data about the FBA module currently installed (e.g. component versions and status).

The Parameters Description section lists the group 51 parameters.

# Activate Drive Control Functions – FBA

Fieldbus control of various drive functions requires configuration to:

- Tell the drive to accept fieldbus control of the function.
- Define as a fieldbus input, any drive data required for control.
- Define as a fieldbus output, any control data required by the drive.

The following sections describe, at a general level, the configuration required for each control function. The last column in each table below is deliberately blank. See the user's manual supplied with the FBA module for the appropriate entry.

### Start/Stop Direction Control

Using the fieldbus for start/stop/direction control of the drive requires:

- Drive parameter values set as defined below.
- Fieldbus controller supplied command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

| Drive Parameter | | Value | Description | Protocol Reference |
|---|---|---|---|---|
| 1001 | EXT1 COMMANDS | 10 (COMM) | Start/Stop controlled by fieldbus with Ext1 selected. | |

| Drive Parameter | | Value | Description | Protocol Reference |
|---|---|---|---|---|
| 1002 | EXT2 COMMANDS | 10 (COMM) | Start/Stop by controlled fieldbus with Ext2 selected. | |
| 1003 | DIRECTION | 3 (REQUEST) | Direction controlled by fieldbus. | |

### Input Reference Select

Using the fieldbus to provide input reference to the drive requires:

- Drive parameter value set as defined below.
- Fieldbus controller supplied reference word(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

| Drive Parameter | | Value | Description | Protocol Reference |
|---|---|---|---|---|
| 1102 | EXT1/EXT2 SEL | 8 (COMM) | Ref. selected by fieldbus. (Required only if 2 references used.) | |
| 1103 | REF1 SEL | 8 (COMM)<br>9 (COMM+AI1)<br>10 (COMM*AI1) | Input reference 1supplied by fieldbus. | |
| 1106 | REF2 SEL | 8 (COMM)<br>9 (COMM+AI)<br>10 (COMM*AI) | Input reference 1 supplied by fieldbus. (Required only if 2 references used.) | |

**Note!** Multiple references are supported only when using the ABB Drives profile.

*Scaling*

Where required, REFERENCES can be scaled. See the "Reference Scaling" in the following sections, as appropriate:

- "ABB Drives Profile Technical Data"
- "Generic Profile Technical Data"

### System Control

Using the fieldbus for miscellaneous drive control requires:

- Drive parameter values set as defined below.
- Fieldbus controller command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

| Drive Parameter | | Value | Description | Protocol Reference |
|---|---|---|---|---|
| 1601 | RUN ENABLE | 7 (COMM) | Run enable by fieldbus. | |
| 1604 | FAULT RESET SEL | 8 (COMM) | Fault reset by fieldbus. | |
| 1607 | PARAM SAVE | 1 (SAVE) | Saves altered parameters to memory (then value returns to 0). | |

### Relay Output Control

Using the fieldbus for relay output control requires:

- Drive parameter values set as defined below.
- Fieldbus controller supplied, binary coded, relay command(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

| Drive Parameter | | Value | Description | Protocol Reference |
|---|---|---|---|---|
| 1401 | RELAY OUTPUT 1 | 35 (COMM)<br>36 (COMM(-1)) | Relay Output 1 controlled by fieldbus. | |
| 1402 | RELAY OUTPUT 2 | | Relay Output 2 controlled by fieldbus. | |
| 1403 | RELAY OUTPUT 3 | | Relay Output 3 controlled by fieldbus. | |
| 1410[1] | RELAY OUTPUT 4 | | Relay Output 4 controlled by fieldbus. | |
| 1411[1] | RELAY OUTPUT 5 | | Relay Output 5 controlled by fieldbus. | |
| 1412[1] | RELAY OUTPUT 6 | | Relay Output 6 controlled by fieldbus. | |

1. More than 3 relays requires the addition of a relay extension module.

**Note!** Relay status feedback occurs without configuration as defined below.

| Drive Parameter | | Value | Protocol Reference |
|---|---|---|---|
| 0122 | RO 1-3 STATUS | Relay 1…3 status. | |
| 0123 | RO 4-6 STATUS | Relay 4…6 status. | |

### Analog Output Control

Using the fieldbus for analog output control (e.g. PID setpoint) requires:

- Drive parameter values set as defined below.
- Fieldbus controller supplied analog value(s) in the appropriate location. (The location is defined by the Protocol Reference, which is protocol dependent.)

| Drive Parameter | | Value | Description | Protocol Reference |
|---|---|---|---|---|
| 1501 | AO1 CONTENT SEL | 135 (COMM VALUE 1) | Analog Output 1 controlled by writing to parameter 0135. | – |
| 0135 | COMM VALUE 1 | – | | |
| 1502<br>…<br>1505 | AO1 CONTENT MIN<br>…<br>MAXIMUM AO1 | Set appropriate values. | Used for scaling | – |
| 1506 | FILTER AO1 | | Filter time constant for AO1. | – |
| 1507 | AO2 CONTENT SEL | 136 (COMM VALUE 2) | Analog Output 2 controlled by writing to parameter 0136. | – |
| 0136 | COMM VALUE 2 | – | | |
| 1508<br>…<br>1511 | AO2 CONTENT MIN<br>…<br>MAXIMUM AO2 | Set appropriate values. | Used for scaling | – |
| 1512 | FILTER AO2 | | Filter time constant for AO2. | – |

### PID Control Setpoint Source

Using the fieldbus for the PID control setpoint requires:

- Drive parameter values set as defined below.
- Fieldbus controller supplied setpoint value in the appropriate location. (As defined in "Analog Output Control" above.)

| Drive Parameter | | Value | Description | Protocol Reference |
|---|---|---|---|---|
| 4010 | SETPOINT SEL | 8 (COMM VALUE 1)<br>9 (COMM + AI1)<br>10 (COMM*AI1) | Setpoint is 0135 value (plus or times AI1) | – |

### Communication Fault

When using fieldbus control, specify the drive's action if serial communication is lost.

| Drive Parameter | | Value | Description | Protocol Reference |
|---|---|---|---|---|
| 3018 | COMM FAULT FUNC | 0 (NOT SEL)<br>1 (FAULT)<br>2 (CONST SP7)<br>3 (LAST SPEED) | Set for appropriate drive response. | – |
| 3019 | COMM FAULT TIME | Set time delay before acting on a communication loss. | | – |

## Feedback from the Drive – FBA

Inputs to the controller (drive outputs) have pre-defined meanings established by the protocol. This feedback does not require drive configuration. The following table lists a sample of feedback data. For a complete listing, see all parameters listed in "Parameter Descriptions".

| Drive Parameter | | Protocol Reference |
|---|---|---|
| 0102 | SPEED | |
| 0103 | FREQ OUTPUT | |
| 0104 | CURRENT | |
| 0105 | TORQUE | |
| 0106 | POWER | |
| 0107 | DC BUS VOLT | |
| 0109 | OUTPUT VOLTAGE | |
| 0301 | FB STATUS WORD – bit 0 (STOP) | |
| 0301 | FB STATUS WORD – bit 2 (REV) | |
| 0118 | DI1-3 STATUS – bit 1 (DI3) | |

### Scaling

To scale the drive parameter values see the "Actual Value Scaling" in the following sections, as appropriate:

- "ABB Drives Profile Technical Data"
- "Generic Profile Technical Data"

# Diagnostics – FBA

## Fault Handling

The ACH550 provides fault information as follows:

- The control panel display shows a fault code and text. See "Diagnostics" starting on page 212 for a complete description.
- Parameters 0401 LAST FAULT, 0402 PREVIOUS FAULT1 and 0403 PREVIOUS FAULT2 store the most recent faults.
- For fieldbus access, the drive reports faults as a hexadecimal value, assigned and coded according to the DRIVECOM specification. See table below. Not all profiles support requesting fault codes using this specification. For profiles that support this specification, the profile documentation defines the proper fault request process.

| Drive Fault Code | | Fieldbus Fault Code (DRIVECOM specification) |
|---|---|---|
| 1 | OVERCURRENT | 2310h |
| 2 | DC OVERVOLT | 3210h |
| 3 | DEV OVERTEMP | 4210h |
| 4 | SHORT CIRC | 2340h |
| 5 | OVERLOAD | FF6Bh |
| 6 | DC UNDERVOLT | 3220h |
| 7 | AI1 LOSS | 8110h |
| 8 | AI2 LOSS | 8110h |
| 9 | MOT TEMP | 4310h |
| 10 | PANEL LOSS | 5300h |
| 11 | ID RUN FAIL | FF84h |
| 12 | MOTOR STALL | 7121h |
| 14 | EXT FAULT 1 | 9000h |
| 15 | EXT FAULT 2 | 9001h |
| 16 | EARTH FAULT | 2330h |
| 17 | UNDERLOAD | FF6Ah |
| 18 | THERM FAIL | 5210h |
| 19 | OPEX LINK | 7500h |
| 20 | OPEX PWR | 5414h |
| 21 | CURR MEAS | 2211h |
| 22 | SUPPLY PHASE | 3130h |
| 23 | ENCODER ERR | 7301h |
| 24 | OVERSPEED | 7310h |

| Drive Fault Code | | Fieldbus Fault Code (DRIVECOM specification) |
|---|---|---|
| 25 | DC HIGH RUSH | FF80h |
| 26 | DRIVE ID | 5400h |
| 27 | CONFIG FILE | 630Fh |
| 28 | SERIAL 1 ERR | 7510h |
| 29 | EFB CON FILE | 6306h |
| 30 | FORCE TRIP | FF90h |
| 31 | EFB 1 | FF92h |
| 32 | EFB 2 | FF93h |
| 33 | EFB 3 | FF94h |
| 34 | MOTOR PHASE | FF56h |
| 35 | OUTPUT WIRING | FF95h |
| 36 | INCOMP SWTYPE | 630Fh |
| 101 | SERF CORRUPT | FF55h |
| 102 | SERF IITFILE | FF55h |
| 103 | SERF MACRO | FF55h |
| 104 | SERF EFBPROT | FF55h |
| 105 | SERF BPFILE | FF55h |
| 201 | DSP T1 OVERLOAD | 6100h |
| 202 | DSP T2 OVERLOAD | 6100h |
| 203 | DSP T3 OVERLOAD | 6100h |
| 204 | DSP STACK ERROR | 6100h |
| 205 | DSP REV ERROR | 5000h |
| 206 | OMIO ID ERROR | 5000h |
| 207 | EFB LOAD ERR | 6100h |
| 1000 | PAR HZRPM LIMITS | 6320h |
| 1001 | PAR PFAREFNG | 6320h |
| 1002 | PAR PFAIOCNF | 6320h |
| 1003 | PAR AI SCALE | 6320h |
| 1004 | PAR AO SCALE | 6320h |
| 1005 | PAR PCU 2 | 6320h |
| 1006 | PAR EXT RO | 6320h |
| 1007 | PAR FBUS | 6320h |
| 1008 | PAR PFA MODE | 6320h |
| 1009 | PAR PCU 1 | 6320h |
| 1010 | PAR PFA OVERRIDE | 6320h |
| 1011 | PAR OVERRIDE PARS | 6320h |

### Serial Communication Diagnostics

Besides the drive fault codes, the FBA module has diagnostic tools. Refer to the user's manual supplied with the FBA module.

# ABB Drives Profile Technical Data

## Overview

The ABB Drives profile provides a standard profile that can be used on multiple protocols, including protocols available on the FBA module. This section describes the ABB Drives profile implemented for FBA modules.

## Control Word

As described earlier in "Control Interface" the CONTROL WORD is the principal means for controlling the drive from a fieldbus system.

The following table and the state diagram later in this sub-section describe the CONTROL WORD content for the ABB Drives profile.

| ABB Drives Profile (FBA) CONTROL WORD | | | | |
|---|---|---|---|---|
| **Bit** | **Name** | **Value** | **Commanded State** | **Comments** |
| 0 | OFF1 CONTROL | 1 | READY TO OPERATE | Enter READY TO OPERATE |
| | | 0 | EMERGENCY OFF | Drive ramps to stop according to currently active deceleration ramp (2203 or 2205)<br>Normal command sequence:<br>• Enter OFF1 ACTIVE<br>• Proceed to READY TO SWITCH ON, unless other interlocks (OFF2, OFF3) are active. |
| 1 | OFF2 CONTROL | 1 | OPERATING | Continue operation (OFF2 inactive) |
| | | 0 | EMERGENCY OFF | Drive coasts to stop.<br>Normal command sequence:<br>• Enter OFF2 ACTIVE<br>• Proceed to SWITCHON INHIBITED |
| 2 | OFF3 CONTROL | 1 | OPERATING | Continue operation (OFF3 inactive) |
| | | 0 | EMERGENCY STOP | Drive stops within in time specified by parameter 2208.<br>Normal command sequence:<br>• Enter OFF3 ACTIVE<br>• Proceed to SWITCH ON INHIBITED<br>**WARNING! Be sure motor and driven equipment can be stopped using this mode.** |
| 3 | INHIBIT OPERATION | 1 | OPERATION ENABLED | Enter OPERATION ENABLED (Note the Run enable signal must be active. See 1601. If 1601 is set to COMM, this bit also actives the Run Enable signal.) |
| | | 0 | OPERATION INHIBITED | Inhibit operation. Enter OPERATION INHIBITED |
| 4 | RAMP_OUT_ ZERO | 1 | NORMAL OPERATION | Enter RAMP FUNCTION GENERATOR: ACCELERATION ENABLED |
| | | 0 | RFG OUT ZERO | Force ramp function generator output to Zero. Drive ramps to stop (current and DC voltage limits in force). |

| ABB Drives Profile (FBA) CONTROL WORD | | | | |
|---|---|---|---|---|
| **Bit** | **Name** | **Value** | **Commanded State** | **Comments** |
| 5 | RAMP_HOLD | 1 | RFG OUT ENABLED | Enable ramp function.<br>Enter RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED |
| | | 0 | RFG OUT HOLD | Halt ramping (Ramp Function Generator output held) |
| 6 | RAMP_IN_ ZERO | 1 | RFG INPUT ENABLED | Normal operation. Enter OPERATING |
| | | 0 | RFG INPUT ZERO | Force Ramp Function Generator input to zero. |
| 7 | RESET | 0=>1 | RESET | Fault reset if an active fault exists (Enter SWITCH-ON INHIBITED). Effective if 1604 = COMM. |
| | | 0 | OPERATING | Continue normal operation |
| 8…9 | Unused | | | |
| 10 | REMOTE_CMD | 1 | | Fieldbus control enabled |
| | | 0 | | • CW ≠ 0 or Ref ≠ 0: Retain last CW and Ref.<br>• CW = 0 and Ref = 0: Fieldbus control enabled.<br>• Ref and deceleration/acceleration ramp are locked. |
| 11 | EXT CTRL LOC | 1 | EXT2 SELECT | Select external control location 2 (EXT2). Effective if 1102 = COMM. |
| | | 0 | EXT1 SELECT | Select external control location 1 (EXT1). Effective if 1102 = COMM. |
| 12…15 | Unused | | | |

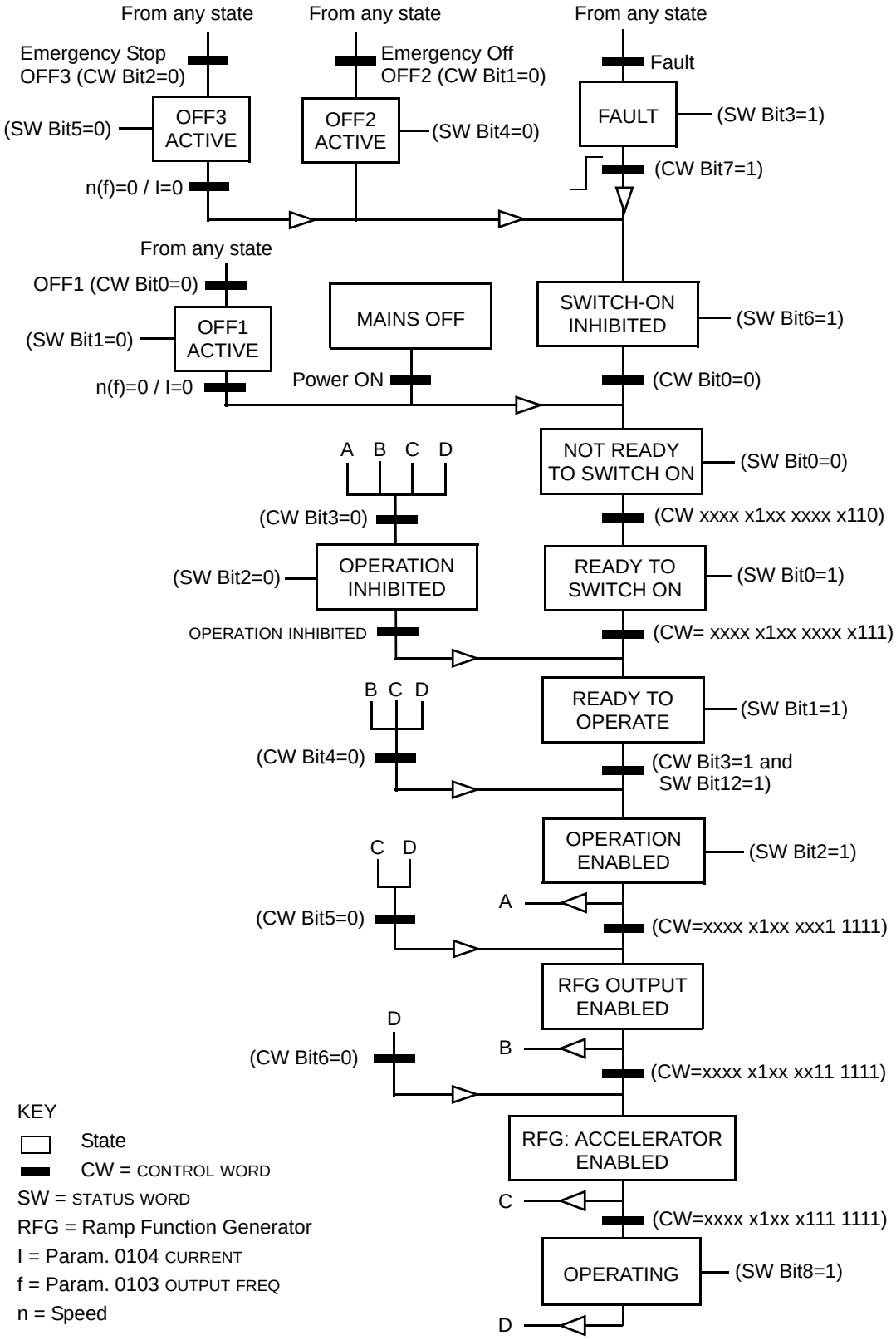
### Status Word

As described earlier in "Control Interface", the contents of the STATUS WORD is status information, sent by the drive to the master station. The following table and the state diagram later in this sub-section describe the status word content.

| ABB Drives Profile (FBA) STATUS WORD | | | |
|---|---|---|---|
| **Bit** | **Name** | **Value** | **Description (Correspond to states/boxes in the state diagram)** |
| 0 | RDY_ON | 1 | READY TO SWITCH ON |
| | | 0 | NOT READY TO SWITCH ON |
| 1 | RDY_RUN | 1 | READY TO OPERATE |
| | | 0 | OFF1 ACTIVE |
| 2 | RDY_REF | 1 | OPERATION ENABLED |
| | | 0 | OPERATION INHIBITED |
| 3 | TRIPPED | 0…1 | FAULT |
| | | 0 | No fault |

| ABB Drives Profile (FBA) STATUS WORD | | | |
|---|---|---|---|
| **Bit** | **Name** | **Value** | **Description (Correspond to states/boxes in the state diagram)** |
| 4 | OFF_2_STA | 1 | OFF2 inactive |
| | | 0 | **OFF2 ACTIVE** |
| 5 | OFF_3_STA | 1 | OFF3 inactive |
| | | 0 | **OFF3 ACTIVE** |
| 6 | SWC_ON_INHIB | 1 | SWITCH-ON INHIBIT ACTIVE |
| | | 0 | SWITCH-ON INHIBIT NOT ACTIVE |
| 7 | ALARM | 1 | Warning/alarm (See "Alarm Listing" in the "Diagnostics" section for details on alarms.) |
| | | 0 | No warning/alarm |
| 8 | AT_SETPOINT | 1 | OPERATING**.** Actual value equals (within tolerance limits) the reference value. |
| | | 0 | Actual value is outside tolerance limits (not equal to reference value). |
| 9 | REMOTE | 1 | Drive control location: REMOTE (EXT1 or EXT2) |
| | | 0 | Drive control location: LOCAL |
| 10 | ABOVE_LIMIT | 1 | Supervised parameter's value $\geq$ supervision high limit.<br>Bit remains "1" until supervised parameter's value < supervision low limit.<br>See group 32, Supervision |
| | | 0 | Supervised parameter's value < supervision low limit.<br>Bit remains "0" until supervised parameter's value > supervision high limit.<br>See group 32, Supervision |
| 11 | EXT CTRL LOC | 1 | External control location 2 (EXT2) selected |
| | | 0 | External control location 1 (EXT1) selected |
| 12 | EXT RUN ENABLE | 1 | External Run Enable signal received |
| | | 0 | No External Run Enable signal received |
| 13… 15 | Unused | | |

The state diagram below describes the start-stop function of CONTROL WORD (CW) and STATUS WORD (SW) bits.



## Reference

As described earlier in "Control Interface", the REFERENCE word is a speed or frequency reference.

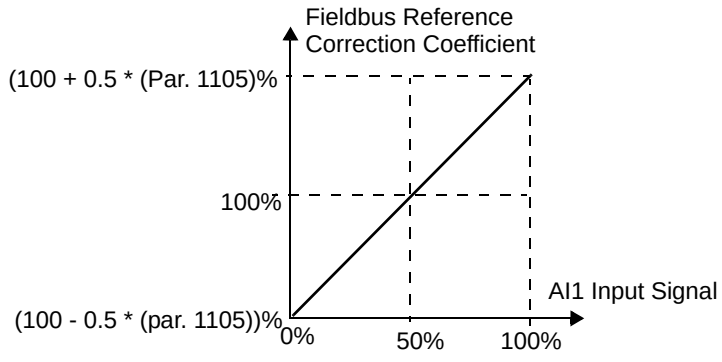
*Reference Scaling*

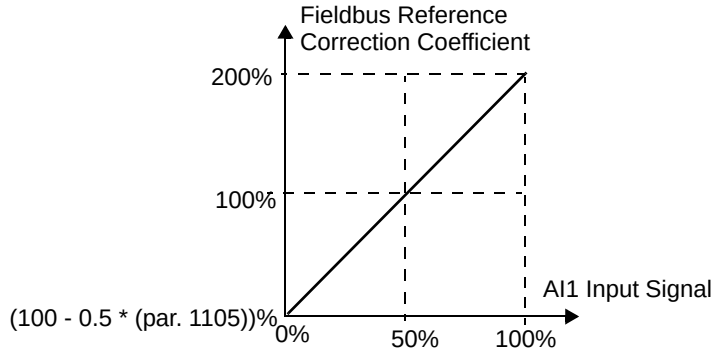
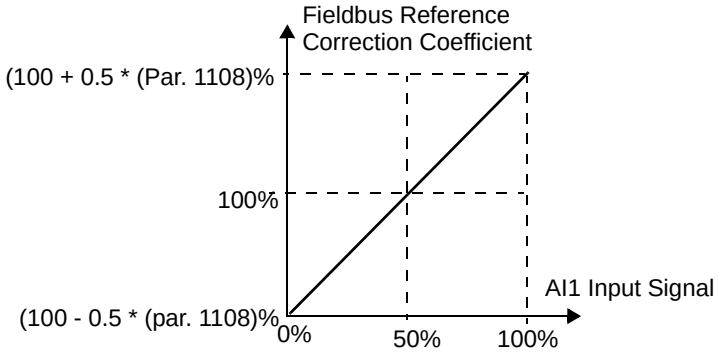
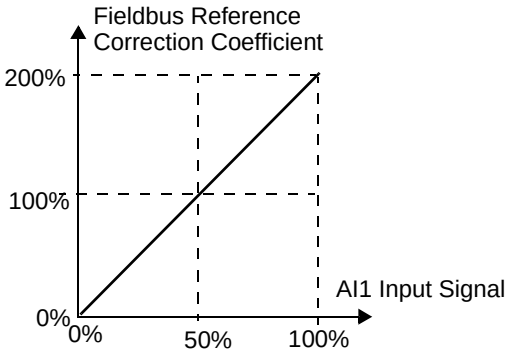
The following table describes REFERENCE scaling for the ABB Drives profile.

| ABB Drives Profile (FBA) | | | | |
|---|---|---|---|---|
| **Reference** | **Range** | **Reference Type** | **Scaling** | **Remarks** |
| REF1 | -32767… +32767 | Speed or frequency | -20000 = -**(par. 1105)**<br>0 = 0<br>+20000 = **(par. 1105)**<br>(20000 corresponds to 100%) | Final reference limited by 1104/1105. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency). |
| REF2 | -32767… +32767 | Speed or frequency | -10000 = -**(par. 1108)**<br>0 = 0<br>+10000 = **(par. 1108)**<br>(10000 corresponds to 100%) | Final reference limited by 1107/1108. Actual motor speed limited by 2001/2002 (speed) or 2007/2008 (frequency). |
| | | Torque | -10000 = -**(par. 1108)**<br>0 = 0<br>+10000 = **(par. 1108)**<br>(10000 corresponds to 100%) | Final reference limited by 2015/2017 (torque1) or 2016/2018 (torque2). |
| | | PID Reference | -10000 = -**(par. 1108)**<br>0 = 0<br>+10000 = **(par. 1108)**<br>(10000 corresponds to 100%) | Final reference limited by 4012/4013 (PID set1) or 4112/4113 (PID set2). |

**Note!** The setting of parameter 1104 REF1 MIN and 1107 REF2 MIN has no effect on the scaling of references.

When parameter 1103 REF1 SELECT or 1106 REF2 SELECT is set to COMM+AI1 or COMM*AI1, the reference is scaled as follows:

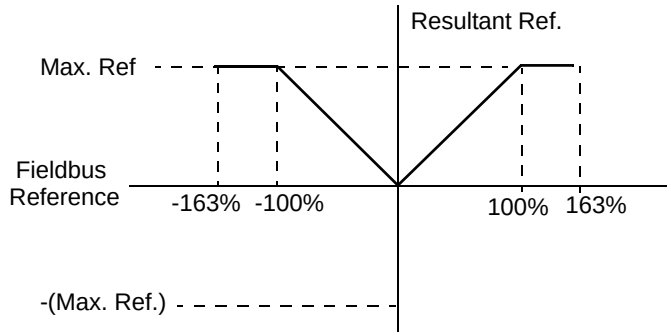
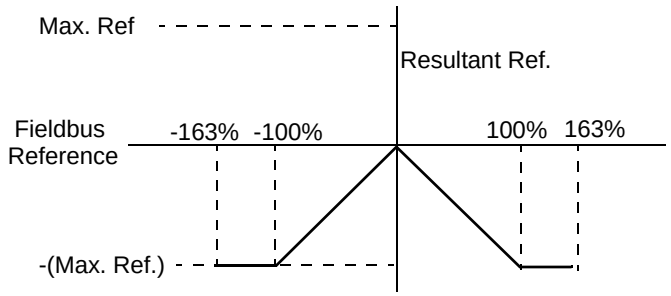
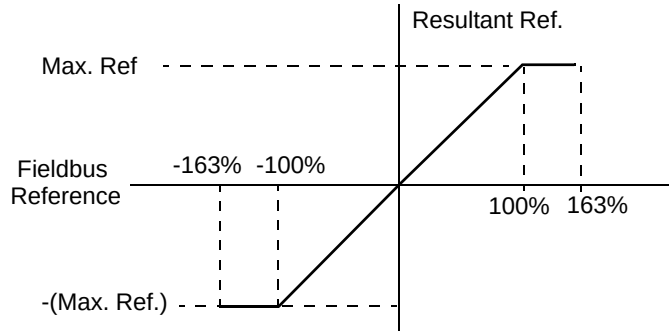
| ABB Drives Profile (FBA) | | |
|---|---|---|
| **Reference** | **Value Setting** | **AI Reference Scaling** |
| REF1 | COMM+AI1 | COMM (%) +(AI (%) - 0.5*REF1 MAX (%))<br>  <br> |

| ABB Drives Profile (FBA) | | |
|---|---|---|
| **Reference** | **Value Setting** | **AI Reference Scaling** |
| REF1 | COMM*AI1 | COMM (%) * (AI (%) / 0.5*REF1 MAX (%))<br>  <br> |
| REF2 | COMM+AI1 | COMM (%) + (AI (%) - 0.5*REF2 MAX (%))<br>  <br> |
| REF2 | COMM*AI1 | COMM (%) * (AI (%) / 0.5*REF2 MAX (%))<br>  <br> |

*Reference Handling*

Use group 10 parameters to configure for control of rotation direction for each control location (EXT1 and EXT2). The following diagrams illustrate how group 10 parameters and the sign of the fieldbus reference interact to produce REFERENCE values (REF1

and REF2). Note, fieldbus references are bipolar, that is they can be positive or negative.

| ABB Drives Profile | | |
|---|---|---|
| **Parameter** | **Value Setting** | **AI Reference Scaling** |
| 1003 DIRECTION | 1 (FORWARD) |  |
| 1003 DIRECTION | 2 (REVERSE) |  |
| 1003 DIRECTION | 3 (REQUEST) |  |

## Actual Value

As described earlier in "Control Interface", Actual Values are words containing drive values.

### *Actual Value Scaling*

The scaling of the integers sent to the fieldbus as Actual Values depends on the resolution of the selected drive parameter. Except as noted for Data Words 5 and 6 below, scale the feedback integer using the resolution listed for the parameter in the "Parameter Descriptions" section. For example:

| Feedback Integer | Parameter Resolution | Scaled Value |
|---|---|---|
| 1 | 0.1 mA | 1 * 0.1 mA = 0.1 mA |
| 10 | 0.1% | 10 * 0.1% = 1% |

Data words 5 and 6 are scaled as follows:

| ABB Drives Profile | | |
|---|---|---|
| **Data Word** | **Contents** | **Scaling** |
| 5 | ACTUAL SPEED | -20000 … +20000 = -(par. 1105) … +(par. 1105) |
| 6 | TORQUE | -10000 … +10000 = -100% … +100% |

*Actual Value Mapping*

See the user's manual supplied with the FBA module.

## Generic Profile Technical Data

### Overview

The generic profile aims to fulfill the industry-standard drive profile for each protocol (e.g. PROFIdrive for PROFIBUS, AC/DC Drive for DeviceNet).

### Control Word

As described earlier in "Control Interface" the CONTROL WORD is the principal means for controlling the drive from a fieldbus system. For specific CONTROL WORD content, see the user's manual provided with the FBA module.

### Status Word

As described earlier in "Control Interface", the contents of the STATUS WORD is status information, sent by the drive to the master station. For specific STATUS WORD content, see the user's manual provided with the FBA module.

### Reference

As described earlier in "Control Interface", the REFERENCE word is a speed or frequency reference.

---

**Note!** REF2 is not supported by the Generic Drive profiles.

---

*Reference Scaling*

REFERENCE scaling is fieldbus type specific. However, at the drive, the meaning of a 100% REFERENCE value is fixed as described in the table below. For a detailed

description on the range and scaling of the REFERENCE, see the user's manual supplied with the FBA module.

| Generic Profile | | | | |
|---|---|---|---|---|
| **Reference** | **Range** | **Reference Type** | **Scaling** | **Remarks** |
| REF | Fieldbus specific | Speed | -100% = -**(par. 9908)**<br>0 = 0<br>+100 = **(par. 9908)** | Final reference limited by 1104/1105.<br>Actual motor speed limited by 2001/ 2002 (speed). |
| | | Frequency | -100% = -**(par. 9907)**<br>0 = 0<br>+100 = **(par. 9907)** | Final reference limited by 1104/1105.<br>Actual motor speed limited by 2007/ 2008 (frequency). |

### Actual Values

As described earlier in "Control Interface", Actual Values are words containing drive values.

*Actual Value Scaling*

For Actual Values, scale the feedback integer using the parameter's resolution. (See "Parameter Descriptions" section for parameter resolutions.) For example:

| Feedback Integer | Parameter Resolution | (Feedback Integer) * (Parameter Resolution) = Scaled Value |
|---|---|---|
| 1 | 0.1 mA | 1 * 0.1 mA = 0.1 mA |
| 10 | 0.1% | 10 * 0.1% = 1% |

Where parameters are in percent, the "Parameter Descriptions" section specifies what parameter corresponds to 100%. In such cases, to convert from percent to engineering units, multiply by the value of the parameter that defines 100% and divide by 100%. For example:

| Feedback Integer | Parameter Resolution | Value of the Parameter that defines 100% | (Feedback Integer) * (Parameter Resolution) * (Value of 100% Ref.) / 100% = Scaled Value |
|---|---|---|---|
| 10 | 0.1% | 1500 rpm[1] | 10 * 0.1% * 1500 RPM / 100% = 15 rpm |
| 100 | 0.1% | 500 Hz[2] | 100 * 0.1% * 500 Hz / 100% = 50 Hz |

1. Assuming, for the sake of this example, that the Actual Value uses parameter 9908 MOT NOM SPEED as the 100% reference, and that 9908 = 1500 rpm.
2. Assuming, for the sake of this example, that the Actual Value uses parameter 9907 MOT NOM FREQ as the 100% reference, and that 9907 = 500 Hz.

*Actual Value Mapping*

See the user's manual supplied with the FBA module.

# Diagnostics

**Warning! Do not attempt any measurement, parts replacement or other service procedure not described in this manual. Such action will void the warranty, may endanger correct operation, and increase downtime and expense.**

**Warning! All electrical installation and maintenance work described in this chapter should only be undertaken by qualified service personnel. The Safety instructions on the first pages of this manual must be followed.**

## Diagnostic Displays

The drive detects error situations and reports them using:

- The green and red LED on the body of the drive
- The status LED on the control panel (if the HVAC control panel is attached to the drive)
- The control panel display (if the HVAC control panel is attached to the drive)
- The Fault Word and Alarm Word parameter bits (parameters 0305 to 0309). See "Group 03: Actual Signals" on page 56.

The form of the display depends on the severity of the error. You can specify the severity for many errors by directing the drive to:

- Ignore the error situation.
- Report the situation as an alarm.
- Report the situation as a fault.

### Red – Faults

The drive signals that it has detected a severe error, or fault, by:

- Enabling the red LED on the drive (LED is either steady on or blinking).
- Setting an appropriate bit in a Fault Word parameter (0305 to 0307).
- Overriding the control panel display with the display of a fault code.
- Stopping the motor (if it was on).

The fault code on the control panel display is temporary. Pressing any of the following buttons removes the fault message: MENU, ENTER, UP button or DOWN button. The message reappears after a few seconds if the control panel is not touched and the fault is still active.

### Flashing Green – Alarms

For less severe errors, called alarms, the diagnostic display is advisory. For these situations, the drive is simply reporting that it had detected something "unusual." In these situations, the drive:

- Flashes the green LED on the drive (does not apply to alarms that arise from control panel operation errors).
- Sets an appropriate bit in an Alarm Word parameter (0308 or 0309). See "Group 03: Actual Signals" on page 56 for the bit definitions.
- Overrides the control panel display with the display of an alarm code and/or name.

Alarm messages disappear from the control panel display after a few seconds. The message returns periodically as long as the alarm condition exists.

## Correcting Faults

The recommended corrective action for faults is:

- Use the "Fault Listing" table below to find and address the root cause of the problem.
- Reset the drive. See "Fault Resetting" on page 217.

### Fault Listing

| Fault Code | Fault Name In Panel | Description and Recommended Corrective Action |
|---|---|---|
| 1 | OVERCURRENT | Output current is excessive. Check for and correct:<br>• Excessive motor load.<br>• Insufficient acceleration time (parameters 2202 ACCELER TIME 1 and 2205 ACCELER TIME 2).<br>• Faulty motor, motor cables or connections. |
| 2 | DC OVERVOLT | Intermediate circuit DC voltage is excessive. Check for and correct:<br>• Static or transient overvoltages in the input power supply.<br>• Insufficient deceleration time (parameters 2203 DECELER TIME 1 and 2206 DECELER TIME 2).<br>• Undersized brake chopper (if present). |
| 3 | DEV OVERTEMP | Drive heatsink is overheated. Temperature is at or above 115 °C (239 °F). Check for and correct:<br>• Fan failure.<br>• Obstructions in the air flow.<br>• Dirt or dust coating on the heat sink.<br>• Excessive ambient temperature.<br>• Excessive motor load. |
| 4 | SHORT CIRC | Fault current. Check for and correct:<br>• A short-circuit in the motor cable(s) or motor.<br>• Supply disturbances. |

| Fault Code | Fault Name In Panel | Description and Recommended Corrective Action |
|---|---|---|
| 5 | OVERLOAD | Inverter overload condition. The drive output current exceeds the ratings given in "Ratings" on page 225. |
| 6 | DC UNDERVOLT | Intermediate circuit DC voltage is not sufficient. Check for and correct:<br>• Missing phase in the input power supply.<br>• Blown fuse.<br>• Undervoltage on mains. |
| 7 | AI1 LOSS | Analog input 1 loss. Analog input value is less than AI1FLT LIMIT (3021). Check for and correct:<br>• Source and connection for analog input.<br>• Parameter settings for AI1FLT LIMIT (3021) and 3001 AI<MIN FUNCTION. |
| 8 | AI2 LOSS | Analog input 2 loss. Analog input value is less than AI2FLT LIMIT (3022). Check for and correct:<br>• Source and connection for analog input.<br>• Parameter settings for AI2FLT LIMIT (3022) and 3001 AI<MIN FUNCTION. |
| 9 | MOT TEMP | Motor is too hot, based on either the drive's estimate or on temperature feedback.<br>• Check for overloaded motor.<br>• Adjust the parameters used for the estimate (3005…3009).<br>• Check the temperature sensors and Group 35 parameters. |
| 10 | PANEL LOSS | Panel communication is lost and either:<br>• Drive is in local control mode (the control panel displays HAND), or<br>• Drive is in remote control mode (REM) and is parameterized to accept start/stop, direction or reference from the control panel.<br>To correct check:<br>• Communication lines and connections<br>• Parameter 3002 PANEL COMM ERROR.<br>• Parameters in Group 10: Command Inputs and Group 11: Reference Select (if drive operation is REM). |
| 11 | ID RUN FAIL | The motor ID run was not completed successfully. Check for and correct:<br>• Motor connections |
| 12 | MOTOR STALL | Motor or process stall. Motor is operating in the stall region. Check for and correct:<br>• Excessive load.<br>• Insufficient motor power.<br>• Parameters 3010…3012. |
| 13 | RESERVED | Not used. |
| 14 | EXTNAL FLT 1 | Digital input defined to report first external fault is active. See parameter 3003 EXTERNAL FAULT 1. |
| 15 | EXTERNAL FLT 2 | Digital input defined to report second external fault is active. See parameter 3004 EXTERNAL FAULT 2. |
| 16 | EARTH FAULT | The load on the input power system is out of balance.<br>• Check for/correct faults in the motor or motor cable.<br>• Verify that motor cable does not exceed max. specified length. |
| 17 | UNDERLOAD | Motor load is lower than expected. Check for and correct:<br>• Disconnected load.<br>• Parameters 3013 UNDERLOAD FUNCTION…3015 UNDERLOAD CURVE. |

| Fault Code | Fault Name In Panel | Description and Recommended Corrective Action |
|---|---|---|
| 18 | THERM FAIL | Internal fault. The thermistor measuring the internal temperature of the drive is open or shorted. Contact your local ABB sales representative. |
| 19 | OPEX LINK | Internal fault. A communication-related problem has been detected on the fiber optic link between the OITF and OINT boards. Contact your local ABB sales representative. |
| 20 | OPEX PWR | Internal fault. Low voltage condition detected on OINT power supply. Contact your local ABB sales representative. |
| 21 | CURR MEAS | Internal fault. Current measurement is out of range. Contact your local ABB sales representative. |
| 22 | SUPPLY PHASE | Ripple voltage in the DC link is too high. Check for and correct:<br>• Missing mains phase.<br>• Blown fuse. |
| 23 | ENCODER ERR | Not used (Available only with encoder and parameter group 50). |
| 24 | OVERSPEED | Motor speed is greater than 120% of the larger (in magnitude) of 2001 MINIMUM SPEED or 2002 MAXIMUM SPEED. Check for and correct:<br>• Parameter settings for 2001 and 2002.<br>• Adequacy of motor braking torque.<br>• Applicability of torque control.<br>• Brake chopper and resistor. |
| 25 | RESERVED | Not used as of the publication of this manual. |
| 26 | DRIVE ID | Internal fault. Configuration Block Drive ID is not valid. Contact your local ABB sales representative. |
| 27 | CONFIG FILE | Internal configuration file has an error. Contact your local ABB sales representative. |
| 28 | SERIAL 1 ERR | Fieldbus communication has timed out. Check for and correct:<br>• Fault setup (3018 COMM FAULT FUNC and 3019 COMM FAULT TIME).<br>• Communication settings (Group 51 or 53 as appropriate).<br>• Poor connections and/or noise on line. |
| 29 | EFB CONFIG FILE | Error in reading the configuration file for the fieldbus adapter. |
| 30 | FORCE TRIP | Fault trip forced by the fieldbus. See the fieldbus User's Manual. |
| 31 | EFB 1 | Fault code reserved for the EFB protocol application. These codes are not used as of the publication of this manual. |
| 32 | EFB 2 | |
| 33 | EFB 3 | |
| 34 | MOTOR PHASE | Fault in the motor circuit. One of the motor phases is lost. Check for and correct:<br>• Motor fault.<br>• Motor cable fault.<br>• Thermal relay fault (if used).<br>• Internal fault. |
| 35 | OUTPUT WIRING | Error in power wiring suspected. Check for and correct:<br>• Input power wired to drive output.<br>• Ground faults. |
| 36 | INCOMP SWTYPE | The wrong software has been loaded onto the drive. Either standard (ACS) software has been loaded onto an ACH drive, or HVAC (ACH) software has been loaded on an ACS drive. |

| Fault Code | Fault Name In Panel | Description and Recommended Corrective Action |
|---|---|---|
| 101 | SERF CORRUPT | Error internal to the drive. Contact your local ABB sales representative and report the error number. |
| 102 | SERF IITFILE | |
| 103 | SERF MACRO | |
| 104 | SERF EFBPROT | |
| 105 | SERF BPFILE | |
| 201 | DSP T1 OVERLOAD | Error in the system. Contact your local ABB sales representative and report the error number. |
| 202 | DSP T2 OVERLOAD | |
| 203 | DSP T3 OVERLOAD | |
| 204 | DSP STACK ERROR | |
| 205 | DSP REV ERROR | |
| 206 | OMIO ID ERROR | |
| 207 | EFB LOAD ERR | |
| 1000 | PAR HZRPM LIMITS | Parameter values are inconsistent. Check for any of the following:<br>• 2001 MINIMUM SPEED > 2002 MAXIMUM SPEED.<br>• 2007 MINIMUM FREQ > 2008 MAXIMUM FREQ.<br>• 2001 MINIMUM SPEED or 9908 MOTOR NOM SPEED is outside of the range: -128…128.<br>• 2002 MAXIMUM SPEED or 9908 MOTOR NOM SPEED is outside of the range: -128…128.<br>• 2007 MINIMUM FREQ or 9907 MOTOR NOM FREQ is outside of the range: -128…128.<br>• 2008 MAXIMUM FREQ or 9907 MOTOR NOM FREQ is outside of the range: -128…128. |
| 1001 | PAR PFAREFNG | Parameter values are inconsistent. Check for the following:<br>• 2007 MINIMUM FREQ is negative, when 8123 PFA ENABLE is active. |
| 1002 | PAR PFAIOCNF | Parameter values are inconsistent. The number of programmed PFA relays does not match with Interlock configuration, when 8123 PFA ENABLE is active. Check consistency of:<br>• RELAY OUTPUT parameters 1401…1403, and 1410…1412.<br>• 8117 NR OF AUX MOTORS, 8118 AUTOCHANGE INTERV, and 8120 INTERLOCKS. |
| 1003 | PAR AI SCALE | Parameter values are inconsistent. Check for any of the following:<br>• 1301 AI 1 MIN > 1302 AI 1 MAX.<br>• 1304 AI 2 MIN > 1305 AI 2 MAX. |
| 1004 | PAR AO SCALE | Parameter values are inconsistent. Check for any of the following:<br>• 1504 AO 1 MIN > 1505 AO 1 MAX.<br>• 1510 AO 2 MIN > 1511 AO 2 MAX. |
| 1005 | PAR PCU 2 | Parameter values for power control are inconsistent: Improper motor nominal kVA or motor nominal power. Check for the following:<br>• $1.1 \leq$ (9906 MOTOR NOM CURR * 9905 MOTOR NOM VOLT * 1.73 / $P_N$) $\leq 2.6$<br>• Where: $P_N$ = 1000 * 9909 MOTOR NOM POWER (if units are kW) or $P_N$ = 746 * 9909 MOTOR NOM POWER (if units are HP, e.g. in US) |

| Fault Code | Fault Name In Panel | Description and Recommended Corrective Action |
|---|---|---|
| 1006 | PAR EXT RO | Parameter values are inconsistent. Check for the following:<br>• Extension relay module not connected and<br>• 1410…1412 RELAY OUTPUTS 4…6 have non-zero values. |
| 1007 | PAR FBUS | Parameter values are inconsistent. Check for and correct:<br>• A parameter is set for fieldbus control (e.g. 1001 EXT1 COMMANDS = 10 (COMM)), but 9802 COMM PROT SEL = 0. |
| 1008 | PAR PFAMODE | Parameter values are inconsistent – 9904 MOTOR CTRL MODE must be = 3 (SCALAR: SPEED), when 8123 PFA ENABLE is activated. |
| 1009 | PAR PCU 1 | Parameter values for power control are inconsistent: Improper motor nominal frequency or speed. Check for both of the following:<br>• 1 ≤ (60 * 9907 MOTOR NOM FREQ / 9908 MOTOR NOM SPEED ≤ 16<br>• 0.8 ≤ 9908 MOTOR NOM SPEED / (120 * 9907 MOTOR NOM FREQ / Motor Poles) ≤ 0.992 |
| 1010 | PAR PFA OVERRIDE | Both the override mode and PFA are activated at the same time. These modes are mutually incompatible, because PFA interlocks cannot be observed in the override mode. |
| 1011 | PAR OVERRIDE PARS | Overeride is enabled, but parameters are incompatible. Verify that1701 is not zero, and (depending on 9904 value) 1702 or 1703 is not zero. |

### Fault Resetting

The ACH550 can be configured to automatically reset certain faults. Refer to parameter Group 31: Automatic Reset.

**Warning! If an external source for start command is selected and it is active, the ACH550 may start immediately after fault reset.**

*Flashing Red LED*

To reset the drive for faults indicated by a flashing red LED:

- Turn off the power for 5 minutes.

*Red LED*

To reset the drive for faults indicated by a red LED (on, not flashing), correct the problem and do one of the following:

- From the control panel, press RESET
- Turn off the power for 5 minutes.

Depending on the value of 1604, FAULT RESET SELECT, the following could also be used to reset the drive:

- Digital input
- Serial communication

When the fault has been corrected, the motor can be started.

### History

For reference, the last three fault codes are stored into parameters 0401, 0412, 0413. For the most recent fault (identified by parameter 0401), the drive stores additional data (in parameters 0402…0411) to aid in troubleshooting a problem. For example, parameter 0404 stores the motor speed at the time of the fault.

To clear the fault history (all of the Group 04, Fault History parameters):

1. Using the control panel in Parameters mode, select parameter 0401.
2. Press EDIT.
3. Press UP and Down simultaneously.
4. Press SAVE.

## Correcting Alarms

The recommended corrective action for alarms is:

- Determine if the Alarm requires any corrective action (action is not always required).
- Use "Alarm Listing" below to find and address the root cause of the problem.

### Alarm Listing

The following table lists the alarms by code number and describes each.

| Alarm Code | Display | Description |
|---|---|---|
| 2001 | Reserved | |
| 2002 | | |
| 2003 | | |
| 2004 | DIR LOCK | The change in direction being attempted is not allowed. Either:<br>• Do not attempt to change the direction of motor rotation, or<br>• Change parameter 1003 DIRECTION to allow direction change (if reverse operation is safe). |
| 2005 | I/O COMM | Fieldbus communication has timed out. Check for and correct:<br>• Fault setup (3018 COMM FAULT FUNC and 3019 COMM FAULT TIME).<br>• Communication settings (Group 51 or 53 as appropriate).<br>• Poor connections and/or noise on line. |
| 2006 | AI1 LOSS | Analog input 1 is lost, or value is less than the minimum setting. Check:<br>• Input source and connections<br>• Parameter that sets the minimum (3021)<br>• Parameter that sets the Alarm/Fault operation (3001) |
| 2007 | AI2 LOSS | Analog input 2 is lost, or value is less than the minimum setting. Check:<br>• Input source and connections<br>• Parameter that sets the minimum (3022)<br>• Parameter that sets the Alarm/Fault operation (3001) |

| Alarm Code | Display | Description |
|---|---|---|
| 2008 | PANEL LOSS | Panel communication is lost and either:<br>• Drive is in local control mode (the control panel displays LOC), or<br>• Drive is in remote control mode (REM) and is parameterized to accept start/stop, direction or reference from the control panel.<br>To correct check:<br>• Communication lines and connections<br>• Parameter 3002 PANEL LOSS.<br>• Parameters in groups 10 COMMAND INPUTS and 11 REFERENCE SELECT (if drive operation is REM). |
| 2009 | Reserved | |
| 2010 | MOT OVERTEMP | Motor is hot, based on either the drive's estimate or on temperature feedback. This alarm warns that a Motor Underload fault trip may be near. Check:<br>• Check for overloaded motor.<br>• Adjust the parameters used for the estimate (3005…3009).<br>• Check the temperature sensors and Group 35 parameters. |
| 2011 | UNDERLOAD | Motor load is lower than expected. This alarm warns that a Motor Underload fault trip may be near. Check:<br>• Motor and drive ratings match (motor is NOT undersized for the drive)<br>• Settings on parameters 3013 to 3015 |
| 2012 | MOTOR STALL | Motor is operating in the stall region. This alarm warns that a Motor Stall fault trip may be near. |
| 2013 (note 1) | AUTORESET | This alarm warns that the drive is about to perform an automatic fault reset, which may start the motor.<br>• To control automatic reset, use parameter group 31 AUTOMATIC RESET. |
| 2014 (note 1) | AUTOCHANGE | This alarm warns that the PFA autochange function is active.<br>• To control PFA, use parameter group 81 PFA CONTROL |
| 2015 | PFA INTERLOCK | This alarm warns that the PFA interlocks are active, which means that the drive cannot start the following:<br>• Any motor (when Autochange is used),<br>• The speed regulated motor (when Autochange is not used). |
| 2016 | Reserved | |
| 2017 | OFF BUTTON | Note 1. |
| 2018 (note 1) | PID SLEEP | This alarm warns that the PID sleep function is active, which means that the motor could accelerate when the PID sleep function ends.<br>• To control PID sleep, use parameters 4022…4026 or 4122…4126. |
| 2019 | ID RUN | Performing ID run. |
| 2020 | OVERRIDE | Override mode activated. |
| 2021 | START ENABLE 1 MISSING | This alarm warns that the Start Enable 1 signal is missing.<br>• To control Start Enable 1 function, use parameter 1608.<br>To correct, check:<br>• Digital input configuration.<br>• Communication settings. |

| Alarm Code | Display | Description |
|---|---|---|
| 2022 | START ENABLE 2 MISSING | This alarm warns that the Start Enable 2 signal is missing.<br>• To control Start Enable 2 function, use parameter 1609.<br>To correct, check:<br>• Digital input configuration.<br>• Communication settings. |
| 2023 | EMERGENCY STOP | Emergency stop activated. |

**Note 1.** Even when the relay output is configured to indicate alarm conditions (e.g. parameter 1401 RELAY OUTPUT 1 = 5 (ALARM) or 16 (FLT/ALARM)), this alarm is not indicated by a relay output.

# Maintenance

**Warning! Read "Safety" on page 3 before performing any maintenance on the equipment. Ignoring the safety instructions can cause injury or death.**

## Maintenance Intervals

If installed in an appropriate environment, the drive requires very little maintenance. This table lists the routine maintenance intervals recommended by ABB.

| Maintenance | Interval | Instruction |
|---|---|---|
| Heatsink temperature check and cleaning | Depends on the dustiness of the environment (every 6…12 months) | See "Heatsink" on page 221. |
| Main cooling fan replacement | Every five years | See "Main Fan Replacement" on page 222. |
| Internal enclosure cooling fan replacement (IP 54/UL Type 12 units) | Every three years. | See "Internal Enclosure Fan Replacement" on 223. |
| Capacitor change (Frame sizes R5 and R6) | Every ten years | See "Capacitors" on page 223. |
| HVAC control panel battery change | Every ten years | See “Battery” on page 62. |

## Heatsink

The heatsink fins accumulate dust from the cooling air. Since a dusty heatsink is less efficient at cooling the drive, overtemperature faults become more likely. In a “normal” environment (not dusty, not clean) check the heatsink annually, in a dusty environment check more often.

Clean the heatsink as follows (when necessary):

1. Remove power from drive.
2. Remove the cooling fan (see section "Main Fan Replacement" on page 222).
3. Blow clean compressed air (not humid) from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust.

**Note:** If there is a risk of the dust entering adjoining equipment, perform the cleaning in another room.

4. Replace the cooling fan.
5. Restore power.

## Main Fan Replacement

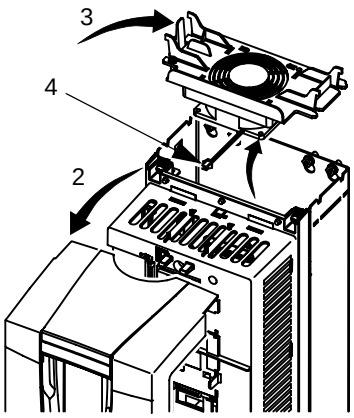
The drive's main cooling fan has a life span of about 60,000 operating hours at maximum rated operating temperature and drive load. The expected life span doubles for each 10 °C (18 °F) drop in the fan temperature (fan temperature is a function of ambient temperatures and drive loads).

Fan failure can be predicted by the increasing noise from fan bearings and the gradual rise in the heatsink temperature in spite of heatsink cleaning. If the drive is operated in a critical part of a process, fan replacement is recommended once these symptoms start appearing. Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

### Frame Sizes R1...R4

To replace the fan:

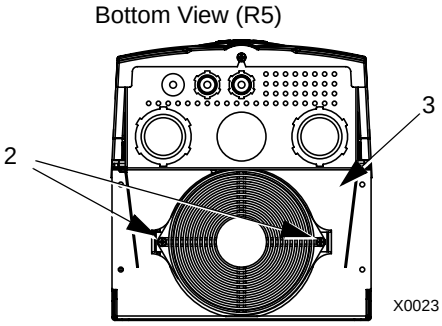
1. Remove power from drive.
2. Remove drive cover.
3. For Frame Size:
   - R1, R2: Press together the retaining clips on the fan cover sides, and lift.
   - R3, R4: Press in on the lever located on the left side of the fan mount, and rotate the fan up and out.
4. Disconnect the fan cable.
5. Install the fan in reverse order.
6. Restore power.

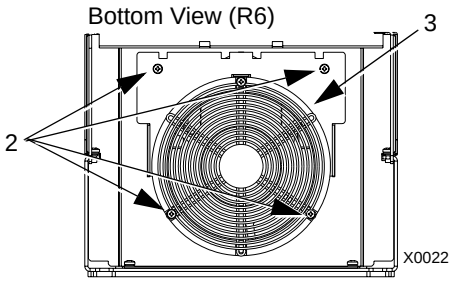



### Frame Sizes R5 and R6

To replace the fan:

1. Remove power from drive.
2. Remove the screws attaching the fan.
3. Disconnect the fan cable.
4. Install the fan in reverse order.
5. Restore power.



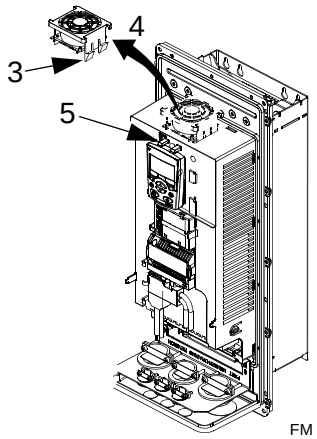



## Internal Enclosure Fan Replacement

IP 54 / UL Type 12 enclosures have an additional internal fan to circulate air inside the enclosure.

### Frame Sizes R1 to R4

To replace the internal enclosure fan in frame sizes R1 to R4:




1. Remove power from drive.
2. Remove the front cover.
3. The housing that holds the fan in place has barbed retaining clips at each corner. Press all four clips toward the center to release the barbs.
4. When the clips/barbs are free, pull the housing up to remove from the drive.
5. Disconnect the fan cable.
6. Install the fan in reverse order, noting that:
   - The fan air flow is up (refer to arrow on fan).
   - The fan wire harness is toward the front.
   - The notched housing barb is located in the right-rear corner.
   - The fan cable connects just forward of the fan at the top of the drive.

### Frame Sizes R5 and R6

To replace the internal enclosure fan in frame sizes R5 or R6:

- Remove power from drive.
- Remove the front cover.
- Lift the fan out and disconnect the cable.
- Install the fan in reverse order.
- Restore power.

## Capacitors

The drive intermediate circuit employs several electrolytic capacitors. Their life span is from 35,000...90,000 hours depending on drive loading and ambient temperature. Capacitor life can be prolonged by lowering the ambient temperature.

It is not possible to predict a capacitor failure. Capacitor failure is usually followed by a input power fuse failure or a fault trip. Contact ABB if capacitor failure is suspected. Replacements for frame size R5 and R6 are available from ABB. Do not use other than ABB specified spare parts.

# Control Panel

## Cleaning

Use a soft damp cloth to clean the control panel. Avoid harsh cleaners which could scratch the display window.

## Battery

A battery is only used in Assistant control panels that have the clock function available and enabled. The battery keeps the clock operating in memory during power interruptions.

The expected life for the battery is greater than ten years. To remove the battery, use a coin to rotate the battery holder on the back of the control panel. Replace the battery with type CR2032.

# Technical Data

## Ratings

By type code, the table below provides ratings for the ACH550 adjustable speed AC drive, including:

- IEC ratings
- NEMA ratings (shaded columns)
- Frame size

### Ratings, 380…480 Volt Drives

Abbreviated column headers are described in "Symbols" on page 226.

| Type Code | Valid up to 40°C (104 °F) | | | Frame Size |
|---|---|---|---|---|
| ACH550-UH-see below | $I_{2N}$ A | $P_N$ kW | $P_N$ HP | |
| Three-phase supply voltage, **380**…**480 V** | | | | |
| -03A3-4 | 3.3 | 1.1 | 1.5 | R1 |
| -04A1-4 | 4.1 | 1.5 | 2 | R1 |
| -06A9-4 | 6.9 | 3 | 3 | R1 |
| -08A8-4 | 8.8 | 4 | 5 | R1 |
| -012A-4 | 11.9 | 5.5 | 7.5 | R1 |
| -015A-4 | 15.4 | 7.5 | 10 | R2 |
| -023A-4 | 23 | 11 | 15 | R2 |
| -031A-4 | 31 | 15 | 20 | R3 |
| -038A-4 | 38 | 18.5 | 25 | R3 |
| -044A-4 | 44 | 22 | 30 | R4 |
| -059A-4 | 59 | 30 | 40 | R4 |
| -072A-4 | 72 | 37 | 50 | R4 |
| -077A-4 | 77 | Note 1 | 60 | R5 |
| -096A-4 | 96 | 45 | 75 | R5 |
| -124A-4 | 124 | 55 | 100 | R6 |
| -157A-4 | 157 | 75 | 125 | R6 |
| -180A-4 | 180 | 90 | 150 | R6 |

1. ACH550-UH-077A-4 is not available in ACH550-01 series.

### Ratings, 208…240 Volt Drives

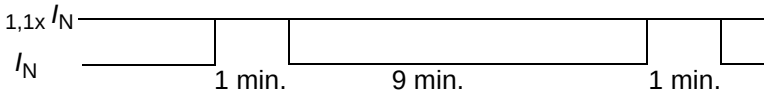
Abbreviated column headers are described in "Symbols" on page 226.

| Type Code | Valid up to 40°C (104 °F) | | | Frame Size |
|---|---|---|---|---|
| ACH550-UH-see below | $I_{2N}$ A | $P_N$ kW | $P_N$ HP | |
| Three-phase supply voltage, 208…240 V | | | | |
| -04A6-2 | 4.6 | 1.1 | 1.0 | R1 |
| -06A6-2 | 6.6 | 1.5 | 1.5 | R1 |
| -07A5-2 | 7.5 | 2.2 | 2.0 | R1 |
| -012A-2 | 11.8 | 3.0 | 3.0 | R1 |
| -017A-2 | 16.7 | 4.0 | 5.0 | R1 |
| -024A-2 | 24.2 | 5.5 | 7.5 | R2 |
| -031A-2 | 30.8 | 7.5 | 10.0 | R2 |
| -046A-2 | 46.2 | 11.0 | 15.0 | R3 |
| -059A-2 | 59.4 | 15.0 | 20.0 | R3 |
| -075A-2 | 74.8 | 18.5 | 25.0 | R4 |
| -088A-2 | 88.0 | 22.0 | 30.0 | R4 |
| -114A-2 | 114 | 30.0 | 40.0 | R4 |
| -143A-2 | 143 | 37.0 | 50.0 | R6 |
| -178A-2 | 178 | 45.0 | 60.0 | R6 |
| -221A-2 | 221 | 55.0 | 75.0 | R6 |
| -248A-2 | 248 | 75.0 | 100 | R6 |

### Symbols

**Typical ratings:**
**Normal use** (10% overload capability)

$I_{2N}$ continuous rms current. 10% overload is allowed for one minute in ten minutes.




$P_N$ typical motor power in normal use. The kilowatt power ratings apply to most IEC, 4-pole motors. The Horsepower ratings apply to most 4-pole NEMA motors.

### Sizing

The current ratings are the same regardless of the supply voltage within one voltage range. To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current.

**Note 1:** The ratings apply in ambient temperature of 40 °C (104 °F).

## Derating

The load capacity (current and power) decreases if the installation site altitude exceeds 1000 meters (3300 ft), or if the ambient temperature exceeds 40 °C (104 °F) or if 8 kHz switching frequency (parameter 2606) is used.

*Temperature Derating*

In the temperature range +40 °C...50 °C (+104 °F...122 °F) the rated output current is decreased 1% for every 1 °C (1.8 °F) above +40 °C (+104 °F). The output current is calculated by multiplying the current given in the rating table by the derating factor.

Example If the ambient temperature is 50 °C (+122 °F) the derating factor is 100% - 1%/°C x 10 °C = 90% or 0.90.
The output current is then 0.90 x $I_{2N}$.

*Altitude Derating*

In altitudes from 1000...4000 m (3300...13,200 ft) above sea level, the derating is 1% for every 100 m (330 ft). If the installation site is higher than 2000 m (6600 ft) above sea level, please contact your local ABB distributor or office for further information.

*Single Phase Supply Derating*

For 208…240 Volt series drives, a single phase supply can be used. In that case, the derating is 50%.

*Switching Frequency Derating*

If the 8 kHz switching frequency (parameter 2606) is used, either:

- Derate $P_N$ and $I_{2N}$ to 80% or
- Set parameter 2607 SW FREQ CTRL = 1 (ON) which allows the drive to reduce the switching frequency if/when the drive's internal temperature exceeds 90 °C. See the parameter description for 2607 for details.

# Input Power Connections

**Warning! Do not operate the drive outside the nominal input line voltage range. Over-voltage can result in permanent damage to the drive.**

## Input Power Specifications

| Input Power Connection Specifications | |
|---|---|
| **Voltage ($U_1$)** | 208/220/230/240 VAC 3-phase (or 1-phase) +10% -15% for 230 VAC units.<br>400/415/440/460/480 VAC 3-phase +10% -15% for 400 VAC units. |
| **Prospective short-circuit current (IEC 629)** | Maximum allowed prospective short-circuit current in the supply is 100 kA in a second providing that the drive's input power is protected with appropriate fuses. US: 100,000 AIC. |
| **Frequency** | 48…63 Hz |
| **Imbalance** | Max. ± 3% of nominal phase to phase input voltage |
| **Fundamental power factor (cos φ)** | 0.98 (at nominal load) |
| **Cable Temperature Rating** | 90 °C (194 °F) rating minimum. |

## Branch Circuit Protection

The ACH550 does not include a disconnect device. A means to disconnect input power must be installed between the AC power source and the ACH550. This branch circuit protection must:

- Be sized to conform to applicable safety regulations, including, but not limited to, both National and local electrical codes.
- Be locked in the open position during installation and maintenance work.

The disconnect device must not be used to control the motor. Instead use the control panel, or commands to the I/O terminals for motor control. Cycling the disconnect device cycles power to the drive's DC capacitors. These capacitors have a maximum limit of 5 cycles in ten minutes.

## Fuses

The following tables provide fuse recommendations for short circuit protection on the drive's input power. These recommendations are not requirements if branch circuit protection is otherwise provided per NEC. UL508A manufacturers are not required to use the recommended fuses for the purpose of UL listing a panel that includes the ACH550.

*380…480 Volt Drives*

| ACH550-UH- see below | Input Current (A) | Input Fuses | | |
|---|---|---|---|---|
| | | IEC269 gG (A) | UL Class T (A) | Bussmann Type |
| -03A3-4 | 3.3 | 10 | 10 | JJS-10 |
| -04A1-4 | 4.1 | | | |
| -06A9-4 | 6.9 | | | |
| -08A8-4 | 8.8 | | 15 | JJS-15 |
| -012A-4 | 11.9 | 16 | | |
| -015A-4 | 15.4 | | 20 | JJS-20 |
| -023A-4 | 23 | 25 | 30 | JJS-30 |
| -031A-4 | 31 | 35 | 40 | JJS-40 |
| -038A-4 | 38 | 50 | 50 | JJS-50 |
| -044A-4 | 44 | | 60 | JJS-60 |
| -059A-4 | 59 | 63 | 80 | JJS-80 |
| -072A-4 | 72 | 80 | 90 | JJS-90 |
| -077A-4 | 77 | | 100 | JJS-100 |
| -096A-4 | 96 | 125 | 125 | JJS-125 |
| -124A-4 | 124 | 160 | 175 | JJS-175 |
| -157A-4 | 157 | 200 | 200 | JJS-200 |
| -180A-4 | 180 | 250 | 250 | JJS-250 |

*208…240 Volt Drives*

| ACH550-UH- see below | Input Current A | Input Fuses | | |
|---|---|---|---|---|
| | | IEC269 gG (A) | UL Class T (A) | Bussmann Type |
| -04A6-2 | 4.6 | 10 | 10 | JJS-10 |
| -06A6-2 | 6.6 | | | |
| -07A5-2 | 7.5 | | | |
| -012A-2 | 11.8 | 16 | 15 | JJS-15 |
| -017A-2 | 16.7 | 25 | 25 | JJS-25 |
| -024A-2 | 24.2 | | 30 | JJS-30 |
| -031A-2 | 30.8 | 40 | 40 | JJS-40 |
| -046A-2 | 46.2 | 63 | 60 | JJS-60 |
| -059A-2 | 59.4 | | 80 | JJS-80 |
| -075A-2 | 74.8 | 80 | 100 | JJS-100 |
| -088A-2 | 88.0 | 100 | 110 | JJS-110 |
| -114A-2 | 114 | 125 | 150 | JJS-150 |
| -143A-2 | 143 | 200 | 200 | JJS-200 |
| -178A-2 | 178 | 250 | 250 | JJS-250 |
| -221A-2 | 221 | 315 | 300 | JJS-300 |
| -248A-2 | 248 | | 350 | JJS-350 |

### Emergency Stop Devices

The overall design of the installation must include emergency stop devices and any other safety equipment that may be needed. Pressing STOP on the drive's control panel does NOT:

- Generate an emergency stop of the motor.
- Separate the drive from dangerous potential.

### Input Power Cables/ Wiring

Input wiring can be either:

- A four conductor cable (three phases and ground/protective earth) routed through conduit.
- Four insulated conductors routed through conduit.

Size wiring according to local safety regulations, appropriate input voltage and the drive's load current. In any case, the conductor must be less than the maximum limit defined by the terminal size (see "Drive's Power Connection Terminals" on page 231).

The table below lists copper and aluminum cable types for different load currents. These recommendations apply only for the conditions listed at the top of the table.

| IEC | | | | NEC | |
|---|---|---|---|---|---|
| Based on:<br>• EN 60204-1 and IEC 60364-5-2/2001<br>• PVC insulation<br>• 30 °C (86 °F) ambient temperature<br>• 70 °C (158 °F) surface temperature<br>• Cables with concentric copper shield<br>• Not more than nine cables laid on cable ladder side by side. | | | | Based on:<br>• NEC Table 310-16 for copper wires<br>• 90 °C (194 °F) wire insulation<br>• 40 °C (104 °F) ambient temperature<br>• Not more than three current-carrying conductors in raceway or cable, or earth (directly buried).<br>• Copper cables with concentric copper shield | |
| **Max Load Current (A)** | **Cu Cable ($mm^2$)** | | **Max Load Current (A)** | **Al Cable ($mm^2$)** | **Max Load Current (A)** | **Cu Wire Size (AWG/kcmil)** |
| 14 | 3x1.5 | | 61 | 3x25 | 22.8 | 14 |
| 20 | 3x2.5 | | 75 | 3x35 | 27.3 | 12 |
| 27 | 3x4 | | 91 | 3x50 | 36.4 | 10 |
| 34 | 3x6 | | 117 | 3x70 | 50.1 | 8 |
| 47 | 3x10 | | 143 | 3x95 | 68.3 | 6 |
| 62 | 3x16 | | 165 | 3x120 | 86.5 | 4 |
| 79 | 3x25 | | 191 | 3x150 | 100 | 3 |
| 98 | 3x35 | | 218 | 3x185 | 118 | 2 |
| 119 | 3x50 | | 257 | 3x240 | 137 | 1 |
| 153 | 3x70 | | 274 | 3x (3x50) | 155 | 1/0 |
| 186 | 3x95 | | 285 | 2x (3x95) | 178 | 2/0 |
| 215 | 3x120 | | | | 205 | 3/0 |

| IEC | | | | | NEC | |
|---|---|---|---|---|---|---|
| Based on:<br>• EN 60204-1 and IEC 60364-5-2/2001<br>• PVC insulation<br>• 30 °C (86 °F) ambient temperature<br>• 70 °C (158 °F) surface temperature<br>• Cables with concentric copper shield<br>• Not more than nine cables laid on cable ladder side by side. | | | | | Based on:<br>• NEC Table 310-16 for copper wires<br>• 90 °C (194 °F) wire insulation<br>• 40 °C (104 °F) ambient temperature<br>• Not more than three current-carrying conductors in raceway or cable, or earth (directly buried).<br>• Copper cables with concentric copper shield | |
| **Max Load Current (A)** | **Cu Cable ($mm^2$)** | | **Max Load Current (A)** | **Al Cable ($mm^2$)** | **Max Load Current (A)** | **Cu Wire Size (AWG/kcmil)** |
| 249 | 3x150 | | | | 237 | 4/0 |
| 284 | 3x185 | | | | 264 | 250 MCM or 2 x 1 |
| | | | | | 291 | 300 MCM or 2 x 1/0 |
| | | | | | 319 | 350 MCM or 2 x 2/0 |

### Ground Connections

For personnel safety, proper operation and to reduce electromagnetic emission/pick-up, the drive and the motor must be grounded at the installation site.

- Conductors must be adequately sized as required by safety regulations.
- Power cable shields must be connected to the drive PE terminal in order to meet safety regulations.
- Power cable shields are suitable for use as equipment grounding conductors only when the shield conductors are adequately sized as required by safety regulations.
- In multiple drive installations, do not connect drive terminals in series.

### Drive's Power Connection Terminals

The following table provides specifications for the drive's power connection terminals.

| Frame Size | U1, V1, W1 and U2, V2, W2 Terminals | | | | Earthing PE Terminal | | | |
|---|---|---|---|---|---|---|---|---|
| | Maximum Wire Size | | Torque | | Maximum Wire Size | | Torque | |
| | *$mm^2$* | *AWG* | Nm | lb-ft | *$mm^2$* | *AWG* | Nm | lb-ft |
| R1 | 6 | 8 | 1.4 | 1.0 | 4 | 10 | 1.4 | 1.0 |
| R2 | 10 | 6 | 1.4 | 1.0 | 10 | 8 | 1.4 | 1.0 |
| R3 | 25 | 3 | 1.8 | 1.3 | 16 | 6 | 1.8 | 1.3 |
| R4 | 50 | 1/0 | 2.0 | 1.5 | 35 | 2 | 2.0 | 1.5 |
| R5 | 70 | 2/0 | 15 | 11.1 | 70 | 2/0 | 15 | 11.1 |
| R6 | 185 | 350 MCM | 40 | 29.5 | 95 | 4/0 | 8 | 5.9 |

## Motor Connections

**Warning! Never connect line power to the drive output terminals: U2, V2 or W2. Line voltage applied to the output can result in permanent damage to the unit. If frequent bypassing is required, use mechanically interlocked switches or contactors.**

**Warning! Do not connect any motor with a nominal voltage less than one half of the drive's nominal input voltage.**

**Warning! Disconnect the drive before conducting any voltage tolerance (Hi-Pot) test or insulation resistance (Megger) test on the motor or motor cables. Do not conduct these tests on the drive.**

### Motor Connection Specifications

| Motor Connection Specifications | | | |
|---|---|---|---|
| **Voltage ($U_2$)** | 0…$U_1$, 3-phase symmetrical, $U_{max}$ at the field weakening point | | |
| **Frequency** | 0…500 Hz | | |
| **Frequency Resolution** | 0.01 Hz | | |
| **Current** | See "Ratings" on page 225. | | |
| **Field Weakening Point** | 10…500 Hz | | |
| **Switching Frequency** | Selectable: 1, 4, or 8 kHz | | |
| **Cable Temperature Rating** | 90 °C (194 °F) rating minimum. | | |
| **Maximum Motor Cable Length** | **Frame Size** | **Max. Motor Cable Length*** | |
| | | **$f_{sw}$ = 1 or 4 kHz** | **$f_{sw}$ = 8 kHz** |
| | R1 | 100 m | 50 m |
| | R2…R4 | 200 m | 100 m |
| | R5…R6 | 300 m | 150 m |

*** Warning! Using a motor cable longer than specified in the chart above may cause permanent damage to the drive.**

### Ground Fault Protection

ACH550 internal fault logic detects ground faults in the drive, motor, or motor cable. This fault logic:

- Is NOT a personal safety or fire protection feature.
- Can be set to trigger only a warning using parameter 3017 EARTH FAULT.
- Could be tripped by leakage currents (input power to ground) associated with the use of an optional RFI/EMC filter.

### Grounding and Routing

*Background*

Motor cables require extra care in grounding and routing. The reasons have to do with the following factors:

- Parasitic capacitance – Capacitors are, essentially, conductors that don't touch, but are in close proximity to each other. So, for example, there is a weak capacitive connection between cables and any conductors they are near. Such unintentional, but inevitable conductive paths are called parasitic capacitors. Currents flowing through these paths often create problems. For example, current leaks to control cables can create noise interference, leaks to the motor can damage bearings, and leaks to the drive or other electronic cabinets can damage components.
- Proximity – As the conductors get closer together, capacitance increases.
- Proximal area – As the area in close proximity increases, the capacitance increases, e.g. close parallel paths increase parasitic capacitance between conductors.
- AC frequency – For a given capacitance, increased AC frequency increases current conductance. Hence, capacitive paths that are negligible at 50/60 Hz can be very significant conductors at 8,000 Hz. Motor cable signals are pulses at up to 8,000 Hz and the common mode frequency can reach 48,000 Hz (8k Hz x 3 phases x 2 pulse edges).
- Alternate paths – Where multiple paths exist, the most conductive path draws the most current. So, the ground wiring must be a significantly better path, in order to reduce the current in the alternate paths, the paths through parasitic capacitors.

The high frequencies associated with motor cables also increase the potential for electromagnetic noise radiation. See "Motor Cable Requirements for CE & C-Tick Compliance" below.

*Motor Cable Shielding*

Motor cables require shielding using conduit, armored cable or power shield cable.

- Conduit – When using conduit:
  - Bridge joints with a ground conductor bonded to the conduit on each side of the joint.
  - Bond conduit run to the drive enclosure.
  - Use a separate conduit run for motor cables (also separate input power and control cables).
  - Use a separate conduit run for each drive.
- Armored Cable – When using armored cable:
  - Use six-conductor (3 phases and 3 grounds), type MC continuous corrugated aluminum armor cable with symmetrical grounds.
  - Armored motor cable can share a cable tray with input power cables, but not with control cables.

- Power Shield Cable – For power shield cable details, see "Motor Cable Requirements for CE & C-Tick Compliance" below.

*Grounding*

See "Ground Connections" in "Input Power Connections" above.

For CE compliant installations and installations where EMC emissions must be minimized, see "Effective Motor Cable Screens" below.

### Drive's Motor Connection Terminals

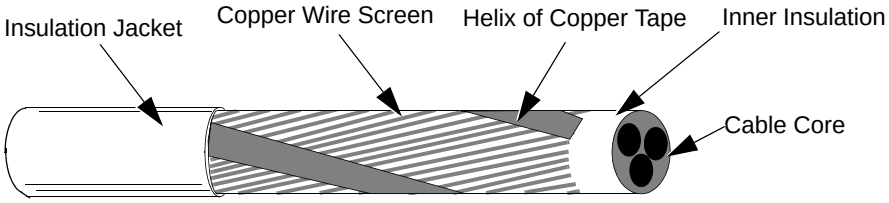
The drive's motor and input power terminals have the same specifications. See "Drive's Power Connection Terminals" above.

### Motor Cable Requirements for CE & C-Tick Compliance

The requirements in this section apply for CE or C-Tick compliance.

*Minimum Requirement (CE & C-Tick)*

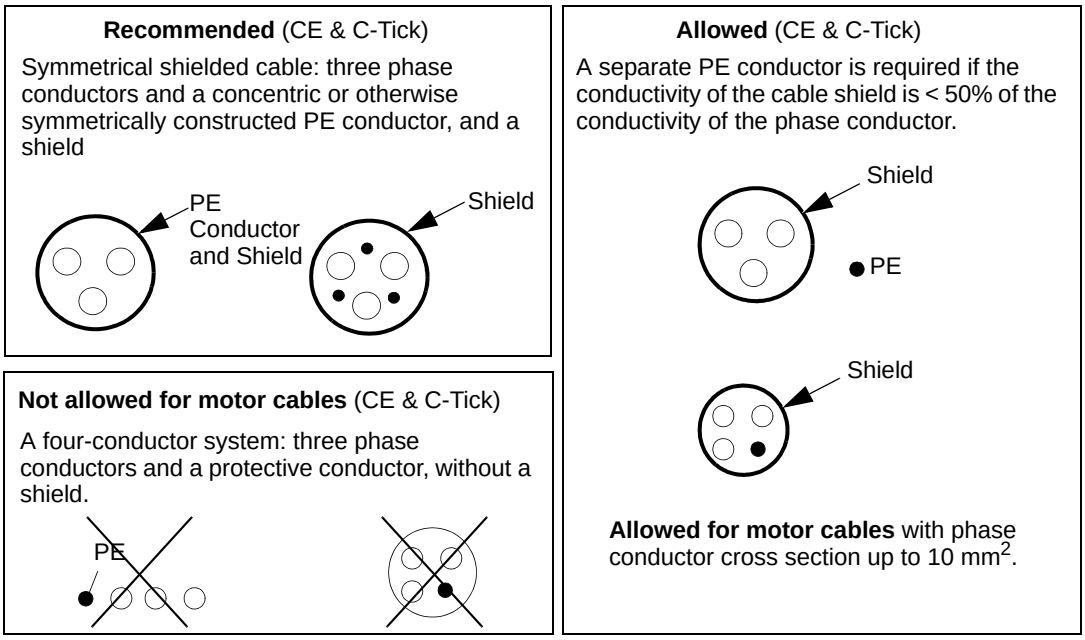
The motor cable must be a symmetrical three conductor cable with a concentric PE conductor or a four conductor cable with a concentric shield, however, a symmetrical constructed PE conductor is always recommended. The following figure shows the minimum requirement for the motor cable screen (for example, MCMK, NK Cables).




* Input filters designed for ACH550 cannot be used in an isolated, or high impedance earthed industrial distribution network.

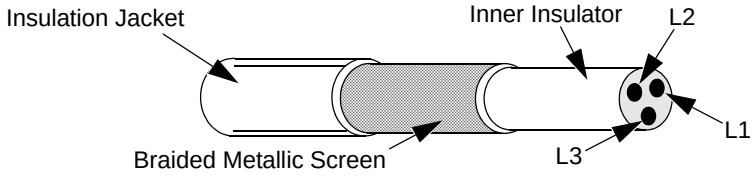
*Recommendation for Conductor Layout*

The following figure compares conductor layout features in motor cables.




*Effective Motor Cable Screens*

The general rule for cable screen effectiveness is: the better and tighter the cable's screen, the lower the radiated emission level. The following figure shows an example of an effective construction (for example Ölflex-Servo-FD 780 CP, Lappkabel or MCCMK, NK Cables).




Clamp the cable shield into the gland plate at the drive end. Twist the cable screen wires together into a bundle not longer than five times its width and connect it to the terminal marked ⏚ (at the bottom right-hand corner of the drive).

At the motor end the motor cable screen must be earthed 360 degrees with an EMC cable gland or the screen wires must be twisted together into a bundle not longer than five times its width and connected to the PE terminal of the motor.

*EN61800-3 Compliant Motor Cables*

To comply with EN61800-3, First and Second Environment (Restricted Distribution) requirements, motor cables:

- Less than or equal to 30 m (100 ft) do not require an RFI/EMC filter.
- Must have an effective screen as described in "Effective Motor Cable Screens" on page 235.
- Must be earthed, at the motor end, with an EMC cable gland.The earthing must contact the cable screen all the way around the cable.

- Longer than 30 m (100 ft) must be limited as specified in the table below. Follow the instructions in the filter package for all cable screen connections.

| Cable Requirements for CE Compliance | | | |
|---|---|---|---|
| **Drive Type** | **RFI/EMC Filter** | **Switching Frequency (Parameter 2606)** | |
| | | **1 or 4 kHz (1 or 4)** | **8 kHz (8)** |
| | | **Maximum motor cable length** | |
| **ACH550-UH**-03A3-4 | ACS400-IF11-3 | 100 m (330 ft) | Not CE compliant for more than 30 m |
| **ACH550-UH**-04A1-4 | | | |
| **ACH550-UH**-06A9-4 | | | |
| **ACH550-UH**-08A8-4 | | | |
| **ACH550-UH**-012A-4 | | | |
| **ACH550-UH**-015A-4 | ACS400-IF21-3 | 100 m (330 ft) | 100 m (330 ft) |
| **ACH550-UH**-023A-4 | | | |
| **ACH550-UH**-031A-4 | ACS400-IF31-3 | 100 m (330 ft) | 100 m (330 ft) |
| **ACH550-UH**-038A-4 | | | |
| **ACH550-UH**-044A-4 | ACS400-IF41-3 | 100 m (330 ft) | 100 m (330 ft) |
| **ACH550-UH**-059A-4 | | | |
| **ACH550-UH**-072A-4 | | | |
| **ACH550-UH**-077A-4 … **ACH550-UH**-180A-4 | Not defined at time of publication. | | |

**Warning! Do not use filters in a floating, or high impedance earthed network.**

# Control Connections

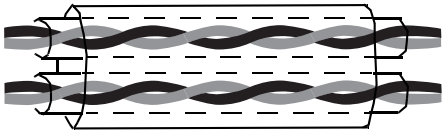
## Control Connection Specifications

| Control Connection Specifications | |
|---|---|
| **Analog Inputs and Outputs** | See table heading "Drive Control Terminal Description" on page 239. |
| **Digital Inputs** | Digital input impedance 1.5 kΩ. Maximum voltage for digital inputs is 30 V. |
| **Relays (Digital Outputs)** | • Max. contact voltage: 30 V DC, 250 V AC<br>• Max. contact current / power: 6 A, 30 V DC; 1500 VA, 250 V AC<br>• Max. continuous current: 2 A rms (cos φ = 1), 1 A rms (cos φ = 0.4)<br>• Minimum load: 500 mW (12 V, 10 mA)<br>• Contact material: Silver-nickel (AgN)<br>• Isolation between relay digital outputs, test voltage: 2.5 kV rms, 1 minute |

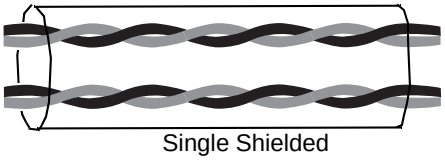
## Control Cables

*General Recommendations*

Use multi-core cables with a braided copper wire screen, temperature rated at 60 °C (140 °F) or above:



Double Shielded
Example: JAMAK by Draka NK Cables



Single Shielded
Example: NOMAK by Draka NK Cables

At the drive end, twist the screen together into a bundle not longer than five times its width and connected to terminal X1-1 (for digital and analog I/O cables) or to either X1-28 or X1-32 (for RS485 cables).

Route control cables to minimize radiation to the cable:

- Route as far away as possible from the input power and motor cables (at least 20 cm (8 in)).
- Where control cables must cross power cables make sure they are at an angle as near 90° as possible.
- Stay at least 20 cm (8 in) from the sides of the drive.

Use care in mixing signal types on the same cable:

- Do not mix analog and digital input signals on the same cable.
- Run relay-controlled signals as twisted pairs (especially if voltage > 48 V). Relay-controlled signals using less than 48 V can be run in the same cables as digital input signals.

---

**Note!** Never mix 24 VDC and 115/230 VAC signals in the same cable.

---

*Analog Cables*

Recommendations for analog signal runs:

- Use double shielded, twisted pair cable.
- Use one individually shielded pair for each signal.
- Do not use a common return for different analog signals.

*Digital Cables*

Recommendations for digital signal runs:

- A double shielded cable is the best alternative, but single-shielded, twisted, multi-pair cable is also usable.

*Control Panel Cable*

If the control panel is connected to the drive with a cable, use only Category 5 Patch ethernet cable.

### Drive's Control Connection Terminals

The following table provides specifications for the drive's control terminals

| Frame Size | Control | | | |
|---|---|---|---|---|
| | Maximum Wire Size | | Torque | |
| | *$mm^2$* | *AWG* | Nm | lb-ft |
| All | 1.5 | 16 | 0.4 | 0.3 |

### Control Terminal Descriptions

The following full-page diagram provides a general description of the control terminals on the drive. For specific application details, see the "Application Macros" on page 35.

---

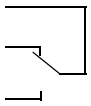
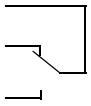
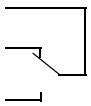
**Note!** Terminals 3, 6, and 9 are at the same potential.

---

---

**Note!** For safety reasons the fault relay signals a "fault" when the ACH550 is powered down.

---

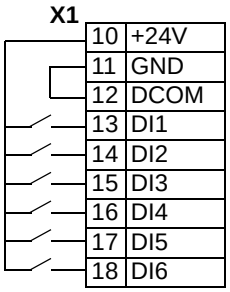
| | X1 | | Drive Control Terminal Description |
|---|---|---|---|
| **Analog I/O** | 1 | SCR | Terminal for signal cable screen. (Connected internally to chassis ground.) |
| | 2 | AI1 | Analog input channel 1, programmable. Default[2] = external reference. Resolution 0.1%, accuracy ±1%. |
| | | | J1:AI1 OFF: 0(2)…10 V ($R_i$ = 312 kΩ) |
| | | | J1:AI1 ON: 0(4)…20 mA ($R_i$ = 100 Ω) |
| | 3 | AGND | Analog input circuit common. (Connected internally to chassis gnd. through 1 MΩ) |
| | 4 | +10 V | 10 V/10 mA reference voltage output for analog input potentiometer, accuracy ±2%. |
| | 5 | AI2 | Analog input channel 2, programmable. Default[2] = PID feedback. Resolution 0.1%, accuracy ±1%. |
| | | | J1:AI2 OFF: 0(2)…10 V ($R_i$ = 312 kΩ) |
| | | | J1:AI2 ON: 0(4)…20 mA ($R_i$ = 100 Ω) |
| | 6 | AGND | Analog input circuit common. (Connected internally to chassis gnd. through 1 MΩ) |
| | 7 | AO1 | Analog output, programmable. Default[2] = frequency. 0…20 mA (load < 500 Ω) |
| | 8 | AO2 | Analog output, programmable. Default[2] = current. 0…20 mA (load < 500 Ω) |
| | 9 | AGND | Analog output circuit common (Connected internally to chassis gnd. through 1 MΩ) |
| **Digital Inputs[1]** | 10 | +24V | Auxiliary voltage output 24 VDC / 250 mA (reference to GND). Short circuit protected. |
| | 11 | GND | Auxiliary voltage output common. (Connected internally as floating.) |
| | 12 | DCOM | Digital input common. To activate a digital input, there must be ≥+10 V (or ≤-10 V) between that input and DCOM. The 24 V may be provided by the ACH550 (X1-10) or by an external 12…24 V source of either polarity. |
| | 13 | DI1 | Digital input 1, programmable. Default[2] = start/stop. |
| | 14 | DI2 | Digital input 2, programmable. Default[2] = not configured. |
| | 15 | DI3 | Digital input 3, programmable. Default[2] = constant (preset) speed. |
| | 16 | DI4 | Digital input 4, programmable. Default[2] = safety interlock. |
| | 17 | DI5 | Digital input 5, programmable. Default[2] = not configured. |
| | 18 | DI6 | Digital input 6, programmable. Default[2] = not configured. |
| **Relay Outputs** | 19 | RO1C |  Relay output 1, programmable. Default[2] = Ready<br>Maximum: 250 VAC / 30 VDC, 2 A<br>Minimum: 500 mW (12 V, 10 mA) |
| | 20 | RO1A | |
| | 21 | RO1B | |
| | 22 | RO2C |  Relay output 2, programmable. Default[2] = Running<br>Maximum: 250 VAC / 30 VDC, 2 A<br>Minimum: 500 mW (12 V, 10 mA) |
| | 23 | RO2A | |
| | 24 | RO2B | |
| | 25 | RO3C |  Relay output 3, programmable. Default[2] = Fault (-1)<br>Maximum: 250 VAC / 30 VDC, 2 A<br>Minimum: 500 mW (12 V, 10 mA) |
| | 26 | RO3A | |
| | 27 | RO3B | |

1 Digital input impedance 1.5 kΩ. Maximum voltage for digital inputs is 30 V.

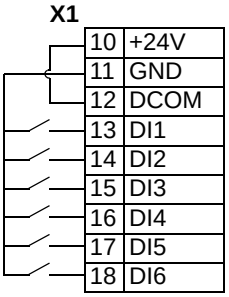
2 Default values depend on the macro used. Values specified are for the HVAC default macro. See "Application Macros" on page 35.

You can wire the digital input terminals in either a PNP or NPN configuration.

PNP connection (source)




NPN connection (sink)




*Serial Communications*

Terminals 28...32 provide RS485 serial communication connections used to control or monitor the drive from a fieldbus controller. See "Serial Communication – EFB" on page 143 for details.

## Efficiency

Approximately 98% at nominal power level.

## Cooling

| Cooling Specifications | |
|---|---|
| **Method** | Internal fan, flow direction from bottom to top. |
| **Requirement** | **Free space around the unit:**<br>• 200 mm (8 in) above and below the unit<br>• 25 mm (1 in) along each side of the unit. |

*Air Flow, 380…480 Volt Drives*

The following table lists heat loss and air flow data for 380…480 Volt drives.

| Drive | | Heat Loss | | Air Flow | |
|---|---|---|---|---|---|
| ACH550-UH- | **Frame Size** | **W** | **BTU/Hr** | **$m^3/h$** | **$ft^3/min$** |
| -03A3-4 | R1 | 40 | 137 | 44 | 26 |
| -04A1-4 | R1 | 52 | 177 | 44 | 26 |
| -06A9-4 | R1 | 97 | 331 | 44 | 26 |
| -08A8-4 | R1 | 127 | 433 | 44 | 26 |
| -012A-4 | R1 | 172 | 587 | 44 | 26 |
| -015A-4 | R2 | 232 | 792 | 88 | 52 |
| -023A-4 | R2 | 337 | 1150 | 88 | 52 |
| -031A-4 | R3 | 457 | 1560 | 134 | 79 |
| -038A-4 | R3 | 562 | 1918 | 134 | 79 |
| -044A-4 | R4 | 667 | 2276 | 280 | 165 |
| -059A-4 | R4 | 907 | 3096 | 280 | 165 |
| -072A-4 | R4 | 1120 | 3820 | 280 | 165 |

| Drive | | Heat Loss | | Air Flow | |
|---|---|---|---|---|---|
| ACH550-UH- | **Frame Size** | **W** | **BTU/Hr** | **$m^3/h$** | **$ft^3/min$** |
| -077A-4 | R5 | 1295 | 4420 | 168 | 99 |
| -096A-4 | R5 | 1440 | 4915 | 168 | 99 |
| -124A-4 | R6 | 1940 | 6621 | 405 | 238 |
| -157A-4 | R6 | 2310 | 7884 | 405 | 238 |
| -180A-4 | R6 | 2810 | 9590 | 405 | 238 |

*Air Flow, 208…240 Volt Drives*

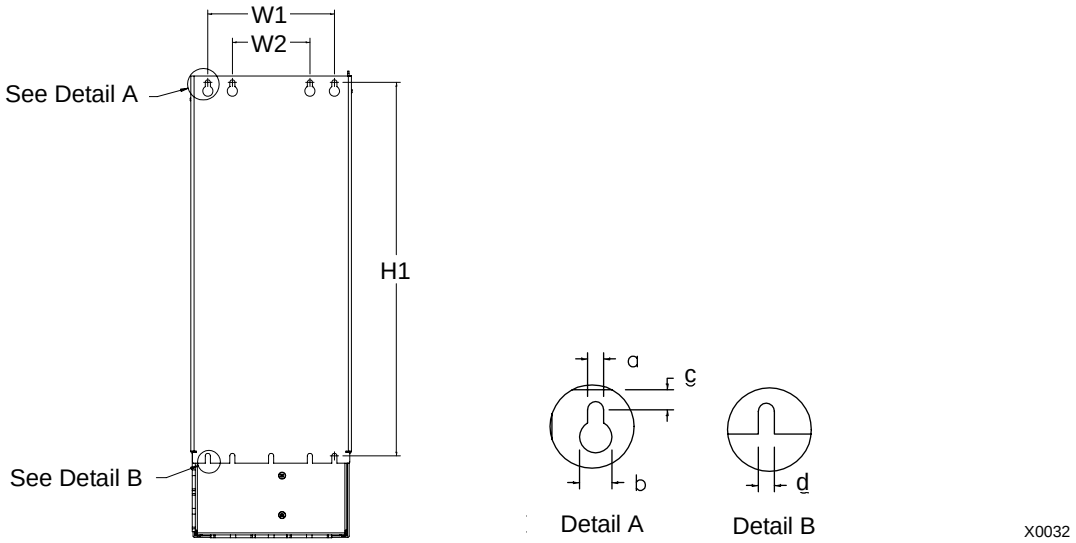
The following table lists heat loss and air flow data for 208…240 Volt drives.

| Drive | | Heat Loss | | Air Flow | |
|---|---|---|---|---|---|
| ACH550-UH- | **Frame Size** | **W** | **BTU/Hr** | **$m^3/h$** | **$ft^3/min$** |
| -04A6-2 | R1 | 55 | 189 | 44 | 26 |
| -06A6-2 | R1 | 73 | 249 | 44 | 26 |
| -07A5-2 | R1 | 81 | 276 | 44 | 26 |
| -012A-2 | R1 | 116 | 404 | 44 | 26 |
| -017A-2 | R1 | 161 | 551 | 44 | 26 |
| -024A-2 | R2 | 227 | 776 | 88 | 52 |
| -031A-2 | R2 | 285 | 373 | 88 | 52 |
| -046A-2 | R3 | 420 | 1434 | 134 | 79 |
| -059A-2 | R3 | 536 | 1829 | 134 | 79 |
| -075A-2 | R4 | 671 | 2290 | 280 | 165 |
| -088A-2 | R4 | 786 | 2685 | 280 | 165 |
| -114A-2 | R4 | 1014 | 3463 | 280 | 165 |
| -143A-2 | R6 | 1268 | 4431 | 405 | 238 |
| -178A-2 | R6 | 1575 | 5379 | 405 | 238 |
| -221A-2 | R6 | 1952 | 6666 | 405 | 238 |
| -248A-2 | R6 | 2189 | 7474 | 405 | 238 |

## Dimensions and Weights

The dimensions and mass for the ACH550 depend on the frame size and enclosure type. If unsure of frame size, first, find the "Type" code on the drive labels. Then look up that type code in the **"Technical Data"** on page 225, to determine the frame size. A complete set of dimensional drawings for ACH550 drives is located in the ACH550 Technical Reference manual.

## Mounting Dimensions




| IP 21 / UL type 1 and IP 54 / UL type 12 – Dimensions for each Frame Size | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ref.** | **R1** | | **R2** | | **R3** | | **R4** | | **R5** | | **R6** | |
| | **mm** | **in** | **mm** | **in** | **mm** | **in** | **mm** | **in** | **mm** | **in** | **mm** | **in** |
| **W1*** | 98.0 | 3.9 | 98.0 | 3.9 | 160 | 6.3 | 160 | 6.3 | 238 | 9.4 | 263 | 10.4 |
| **W2*** | -- | -- | -- | -- | 98.0 | 3.9 | 98.0 | 3.9 | -- | -- | -- | -- |
| **H1*** | 318 | 12.5 | 418 | 16.4 | 473 | 18.6 | 578 | 22.8 | 588 | 23.2 | 675 | 26.6 |
| **a** | 5.5 | 0.2 | 5.5 | 0.2 | 6.5 | 0.25 | 6.5 | 0.25 | 6.5 | 0.25 | 9.0 | 0.35 |
| **b** | 10.0 | 0.4 | 10.0 | 0.4 | 13.0 | 0.5 | 13.0 | 0.5 | 14.0 | 0.55 | 14.0 | 0.55 |
| **c** | 5.5 | 0.2 | 5.5 | 0.2 | 8.0 | 0.3 | 8.0 | 0.3 | 8.5 | 0.3 | 8.5 | 0.3 |
| **d** | 5.5 | 0.2 | 5.5 | 0.2 | 6.5 | 0.25 | 6.5 | 025 | 6.5 | 0.25 | 9.0 | 0.35 |
| **Mounting Hardware** | | | | | | | | | | | | |
| | M5 | #10 | M5 | #10 | M5 | #10 | M5 | #10 | M6 | 1/4 | M8 | 5/16 |

* Center to center dimension.

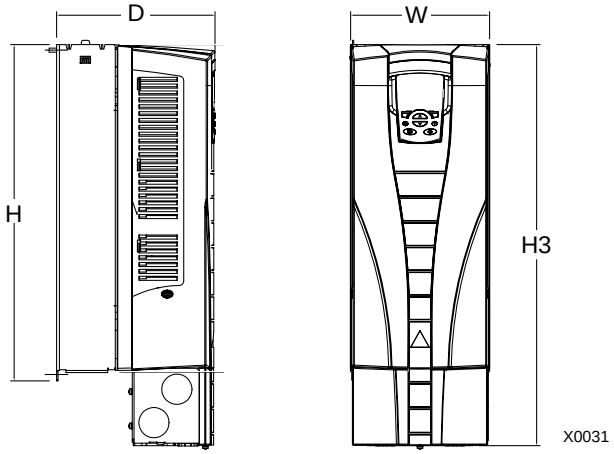
## Weight

The following table lists typical maximum weights for each frame size. Variations within each frame size (due to components associated with voltage/current ratings, and options) are minor.

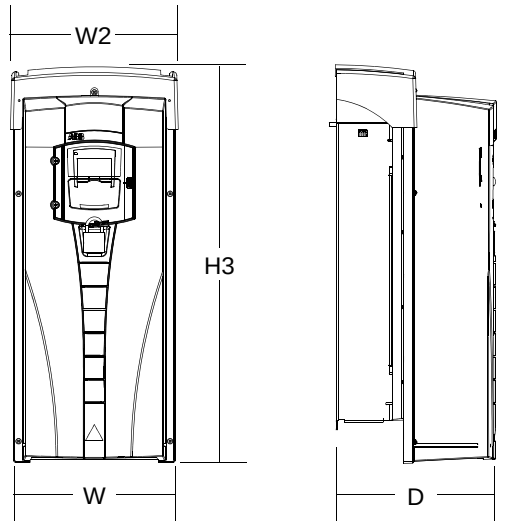
| **Enclosure** | **Weight** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **R1** | | **R2** | | **R3** | | **R4** | | **R5** | | **R6** | |
| | **kg** | **lb.** | **kg** | **lb.** | **kg** | **lb.** | **kg** | **lb.** | **kg** | **lb.** | **kg** | **lb.** |
| **IP 21 / UL type 1** | 6.5 | 14.3 | 9.0 | 19.8 | 16 | 35.0 | 24 | 53.0 | 34 | 75 | 69 | 152 |
| **IP 54 / UL type 12** | 8.4 | 18.6 | 11.5 | 25.4 | 18.1 | 40.0 | 26.6 | 58.7 | 42 | 93 | 86 | 190 |

### Outside Dimensions

Outside dimensions depend on frame size and enclosure type, as defined below.




| IP 21 / UL type 1 – Outside Dimensions by Frame Size | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ref.** | **R1** | | **R2** | | **R3** | | **R4** | | **R5** | | **R6** | |
| | **mm** | **in** | **mm** | **in** | **mm** | **in** | **mm** | **in** | **mm** | **in** | **mm** | **in** |
| **W** | 125 | 4.9 | 125 | 4.9 | 203 | 8.0 | 203 | 8.0 | 265 | 10.4 | 300 | 11.8 |
| **H** | 330 | 13.0 | 430 | 16.9 | 490 | 19.2 | 596 | 23.4 | 602 | 23.7 | 700 | 27.6 |
| **H3** | 369 | 14.5 | 469 | 18.5 | 583 | 23.0 | 689 | 27.1 | 736 | 29.0 | 880 | 34.6 |
| **D** | 212 | 8.3 | 222 | 8.7 | 231 | 9.1 | 262 | 10.3 | 286 | 11.3 | 400 | 15.8 |




| IP 54 / UL type 12 – Outside Dimensions by Frame Size | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ref.** | **R1** | | **R2** | | **R3** | | **R4** | | **R5** | | **R6** | |
| | **mm** | **in** | **mm** | **in** | **mm** | **in** | **mm** | **in** | **mm** | **in** | **mm** | **in** |
| **W** | 213 | 8.4 | 213 | 8.4 | 257 | 10.1 | 257 | 10.1 | 369 | 14.5 | 410 | 16.1 |
| **W2** | 222 | 8.7 | 222 | 8.7 | 267 | 10.5 | 267 | 10.5 | 369 | 14.5 | 410 | 16.1 |
| **H3** | 461 | 18.2 | 561 | 22.1 | 629 | 24.8 | 760 | 29.9 | 776 | 30.5 | 924 | 36.4 |
| **D** | 234 | 9.2 | 246 | 9.7 | 254 | 10.0 | 285 | 11.2 | 309 | 12.2 | 423 | 16.6 |

## Degrees of Protection

Available enclosures:

- IP 21 / UL type 1 enclosure. The site must be free of airborne dust, corrosive gases or liquids, and conductive contaminants such as condensation, carbon dust, and metallic particles.
- IP 54 / UL type 12 enclosure. This enclosure provides protection from airborne dust and light sprays or splashing water from all directions.

Compared to the IP 21 / UL type 1 enclosure, the IP 54 / UL type 12 enclosure has:

- The same internal plastic shell as the IP 21 enclosure
- A different outer plastic cover
- An additional internal fan to improve cooling.
- Larger dimensions
- The same rating (does not require a derating).

## Ambient Conditions

The following table lists the ACH550 environmental requirements.

| **Ambient Environment Requirements** | | |
|---|---|---|
| | **Installation Site** | **Storage and Transportation in the protective package** |
| **Altitude** | • 0…1000 m (0…3,300 ft)<br>• 1000…2000 m (3,300…6,600 ft) if $P_N$ and $I_2$ derated 1% every 100 m above 1000 m (300 ft above 3,300 ft) | |
| **Ambient temperature** | • -15…40 ºC (5…104 ºF)<br>• Max. 50 ºC (122 ºF) if $P_N$ and $I_2$ derated to 90% | -40…70 ºC (-40…158 ºF) |
| **Relative humidity** | < 95% (non-condensing) | |
| **Contamination levels (IEC 721-3-3)** | • No conductive dust allowed.<br>• The ACH550 should be installed in clean air according to enclosure classification.<br>• Cooling air must be clean, free from corrosive materials and free from electrically conductive dust.<br>• Chemical gases: Class 3C2<br>• Solid particles: Class 3S2 | Storage<br>• No conductive dust allowed.<br>• chemical gases: Class 1C2<br>• solid particles: Class 1S2<br>Transportation<br>• No conductive dust allowed.<br>• Chemical gases: Class 2C2<br>• Solid particles: Class 2S2 |
| **Sinusoidal vibration** | • Mechanical conditions: Class 3M4 (IEC60721-3-3)<br>• 2…9 Hz 3.0 mm (0.12 in)<br>• 9…200 Hz 10 $m/s^2$ (33 $ft/s^2$) | In accordance with ISTA 1A and 1B specifications. |
| **Shock (IEC 68-2-29)** | Not allowed | max. 100 $m/s^2$ (330 $ft/s^2$), 11ms (36 fts) |

| Ambient Environment Requirements | | |
|---|---|---|
| | **Installation Site** | **Storage and Transportation in the protective package** |
| **Free fall** | Not allowed | • 76 cm (30 in), frame size R1<br>• 61 cm (24 in), frame size R2<br>• 46 cm (18 in), frame size R3<br>• 31 cm (12 in), frame size R4<br>• 25 cm (10 in), frame size R5<br>• 15 cm (6 in), frame size R6 |

## Materials

| Materials Specifications | |
|---|---|
| **Drive enclosure** | • PC/ABS 2.5 mm, color NCS 1502-Y (RAL 90021 / PMS 420 C and 425 C)<br>• Hot-dip zinc coated steel sheet 1.5…2 mm, thickness of coating 100 micrometers<br>• Cast aluminium AlSi<br>• Extruded aluminium AlSi |
| **Package** | Corrugated board (drives and option modules), expanded polystyrene. Plastic covering of the package: PE-LD, bands PP or steel. |
| **Disposal** | The drive contains raw materials that should be recycled to preserve energy and natural resources. The package materials are environmentally compatible and recyclable. All metal parts can be recycled. The plastic parts can either be recycled or burned under controlled circumstances, according to local regulations. Most recyclable parts are marked with recycling marks.<br>If recycling is not feasible, all parts excluding electrolytic capacitors and printed circuit boards can be landfilled. The DC capacitors contain electrolyte and the printed circuit boards contain lead, both of which will be classified as hazardous waste within the EU. They must be removed and handled according to local regulations.<br>For further information on environmental aspects and more detailed recycling instructions, please contact your local ABB distributor. |

## Applicable Standards

The drive complies with the following standards. The compliance with the European Low Voltage Directive is verified according to standards EN 50178 and EN 60204-1.

| Applicable Standards | |
|---|---|
| EN 50178 (1997) | Electronic equipment for use in power installations |
| EN 60204-1 (1997) | Safety of machinery. Electrical equipment of machines. Part 1: General requirements. *Provisions for compliance:* The final assembler of the machine is responsible for installing:<br>• An emergency-stop device<br>• A supply disconnecting device |
| EN 60529: 1991 (IEC 529), IEC 60664-1 (1992) | Degrees of protection provided by enclosures (IP code) |
| EN 61800-3 (1996) + Amendment A11 (2000) | EMC product standard including specific test methods |
| UL 508C | UL Standard for Safety, Power Conversion Equipment, second edition |

Compliance is valid with the following provisions:

- The motor and control cables are chosen as specified in this manual.
- The installation rules of this manual are followed.

### UL Markings

The ACH550 is UL listed to 100 KAIC without use of input fuses or circuit breaker. For end-users's convenience, section "Branch Circuit Protection" provides fuse recommendations. Branch circuit protection must to be provided, either per NEC, or per the recommendations in "Branch Circuit Protection".

---

**Note!** UL508A manufactures are not required to use the fuse recommendations for the purpose of UL Listing a panel with an ACH550 AFD.

---

The ACH550 has an electronic motor protection feature that complies with the requirements of UL 508C. When this feature is selected and properly adjusted, additional overload protection is not required unless more than one motor is connected to the drive or unless additional protection is required by applicable safety regulations. See parameters 3005 (MOT THERM PROT) and 3006 (MOT THERM TIME).

### EMC (Europe, Australia, and New Zealand)

This section describes conformance with EMC requirements (in Europe, Australia, and New Zealand). For installations in the Unites States and other locations without special EMC requirements, skip to "Control Cables" on page 237.

*CE Marking*

A CE mark is attached to the ACH550 AC drive to verify that the drive follows the provisions of the European Low Voltage and EMC Directives (Directive 73/23/EEC, as amended by 93/68/EEC and Directive 89/336/EEC, as amended by 93/68/EEC).

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used in European Economic Area. The EMC product standard EN 61800-3 covers the requirements stated for drives, such as the ACH550. The drive complies with the First environment (restricted distribution) and Second Environment limits of EN/IEC 61800-3.

*C-Tick Marking*

A C-Tick mark is attached to the ACH550 drive to verify compliance with the relevant standard, IEC 61800-3 (1996) – Adjustable speed electrical power drive systems – Part 3: EMC product standard including specific test methods, mandated by the Trans-Tasman Electromagnetic Compatibility Scheme. The drive complies with the First environment (restricted distribution) and Second Environment limits of EN/IEC 61800-3 with the following provisions:

- The motor and control cables are chosen as specified in this manual.
- The installation instructions in this manual are followed.

*Electromechanical Environments*

Product standard EN 61800-3 (Adjustable speed electrical power drive systems - Part 3: EMC product standard including specific test methods) defines **First Environment** as environment that includes domestic premises. It also includes establishments directly connected without intermediate transformers to a low voltage power supply network which supplies buildings used for domestic purposes.

**Second Environment** includes establishments other than those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

## Liability Limits

The manufacturer is not responsible for:

- Any costs resulting from a failure if the installation, commissioning, repair, alteration, or ambient conditions of the drive do not fulfil the requirements specified in the documentation delivered with the unit and other relevant documentation.
- Units subjected to misuse, negligence or accident.
- Units comprised of materials provided or designs stipulated by the purchaser.

In no event shall the manufacturer, its suppliers or subcontractors be liable for special, indirect, incidental or consequential damages, losses or penalties.

If you have any questions concerning your ABB drive, please contact the local distributor or ABB office. The technical data, information and specifications are valid at the time of printing. The manufacturer reserves the right to modifications without prior notice.

# Index


## Numerics

0xxxx register
EFB function codes . . . 158
EFB mapping . . . 157
1xxxx register
EFB function codes . . . 159
EFB mapping . . . 158
3xxxx register
EFB function codes . . . 160
EFB mapping . . . 159
4xxxx register
EFB function codes . . . 162
EFB mapping . . . 160

## A

acceleration
at aux. stop (PFA), parameter . . . 140
compensation, parameter . . . 91
ramp select, parameter . . . 88
ramp shape, parameter . . . 88
ramp time (PFA), parameter . . . 140
ramp zero select, parameter . . . 89
time, parameter . . . 88
/deceleration, parameter group . . . 88
activate (external PID), parameter . . . 123
actual input (PID), parameters . . . 119
actual max. (PID), parameters . . . 119
actual min. (PID), parameters . . . 119
actual signals, parameter group . . . 56
actual value
mapping, FBA, generic profile . . . 211
actual values
scaling, EFB comm . . . 152
scaling, FBA . . . 200
scaling, FBA, ABB drives profile . . . 209
scaling, FBA, generic profile . . . 211
scaling, FLN fieldbus . . . 182
air flow . . . 240
alarm
codes . . . 218
listing . . . 218
altitude
environment limit . . . 244
shipping limit . . . 244
altitude derating . . . 227
analog cable
requirements . . . 238
analog input
data parameter . . . 54
fault limit, parameters . . . 99
filter, parameters . . . 70
less than min. auto. reset, parameter . . . 100
less than min., fault parameter . . . 96
loss, fault codes . . . 214
maximum, parameters . . . 70
minimum, parameters . . . 70
N2 object listing . . . 173
parameter group . . . 70
ref. correction formula . . . 65
analog I/O
connections . . . 239
specifications . . . 239
analog output
content max., parameters . . . 74
content min., parameters . . . 74
current max., parameters . . . 74
current min., parameters . . . 74
data content, parameters . . . 74
data parameter . . . 54
filter, parameters . . . 75
N2 object listing . . . 175
parameter group . . . 74
application block output, data parameter . . . 53
application macro, parameter . . . 51
applications
see macros
autochange
interval, parameter . . . 134
level, parameter . . . 134
overview . . . 134
starting order counter . . . 135
automatic reset
see reset, automatic
auxiliary motor
see motor, auxiliary

## B

backup
drive parameters . . . 29
battery
assistant control panel . . . 224
baud rate (RS232), parameter . . . 127
binary input
N2 object listing . . . 174
binary output
N2 object listing . . . 176
branch circuit protection . . . 228
break point frequency, fault parameter . . . 97
buffer overruns (count), parameter . . . 127

## C


cable requirements
- grounding . . . 231
- input power . . . 230
- motor . . . 233

CE marking . . . 246
clock . . . 32
com (EFB)
- baud rate, parameter . . . 128
- config file, fault code . . . 215
- control profile, parameter . . . 128
- CRC errors (count), parameter . . . 128
- fault codes . . . 215
- ok messages (count), parameter . . . 128
- parameters . . . 129
- parity, parameter . . . 128
- protocol id, parameter . . . 128
- protocol, parameter group . . . 128
- station id, parameter . . . 128
- status, parameter . . . 128
- UART errors (count), parameter . . . 128

comm
- fault function, parameter . . . 99
- fault time, parameter . . . 99
- protocol select, parameter . . . 142
- relay output word, data parameter . . . 55
- values, data parameter . . . 55

comm (EFB)
- actual value scaling . . . 152
- actual values . . . 151
- also see RS232 . . . 127
- analog output control, activate . . . 150
- comm fault response . . . 151
- configuration . . . 146
- configure for loss of communication . . . 154
- control interface . . . 144
- control word . . . 162
- diagnostics . . . 153
- drive control of functions, activate . . . 147
- exception codes . . . 162
- fault code 28 . . . 154
- fault code 31 . . . 155
- fault code 32 . . . 155
- fault code 33 . . . 155
- fault tracing parameters . . . 153
- fault, duplicate stations . . . 154
- fault, intermittent off-line . . . 155
- fault, no master station on line . . . 154
- fault, swapped wires . . . 154
- feedback from drive . . . 151
- feedback from drive, mailbox . . . 152
- input ref. sel., activate . . . 148
- installation . . . 145
- mailbox, param. read/write . . . 152
- misc. drive control, activate . . . 149
- modbus actual values . . . 162
- normal operation . . . 153
- overview . . . 143
- parameter group . . . 127
- PID control setpoint source, activate . . . 150
- planning . . . 144
- profiles . . . 156
- reference scaling, ABB drives profile . . . 168
- relay output control, activate . . . 149
- set-up . . . 146
- start/stop control, activate . . . 147
- state diagram . . . 167
- status word . . . 164
- termination . . . 145

comm (FBA)
actual values . . . 195
analog output control, activate . . . 199
comm fault response . . . 200
config file CPI firmware revision, parameter 125
config file id revision, parameter . . . 125
config file revision, parameter . . . 125
configuration . . . 197
control interface . . . 194
control word . . . 194
control word, ABB drives . . . 203
diagnostics . . . 201
drive feedback . . . 200
fieldbus control, activate . . . 197
fieldbus CPI firmware revision, parameter . 125
fieldbus parameter refresh, parameter . . . 125
fieldbus parameters . . . 125
fieldbus status, parameter . . . 125
fieldbus type, parameter . . . 125
input ref. sel., activate . . . 198
installation . . . 196
overview . . . 193
parameter group . . . 125
PID control setpoint source, activate . . . 200
planning . . . 195
protocol listing . . . 193
reference . . . 195
relay output control, activate . . . 199
set-up . . . 197
start/stop control, activate . . . 197
state diagram, ABB drives . . . 206
status word . . . 195
status word, ABB drives . . . 204
conduit
kit . . . 12
config file
CPI firmware revision, parameter . . . 125
id revision, parameter . . . 125
revision, parameter . . . 125
config file, fault code . . . 215
connections
EFB comm . . . 145
FBA module . . . 196
constant speed
see speed, constant
construction code . . . 9
contamination levels
environment limit . . . 244
shipping limit . . . 244
contrast, control panel . . . 22
control
connection specifications . . . 237
location, data parameter . . . 53
terminal descriptions . . . 239
control cable
requirements . . . 237
control panel
backup, drive parameters . . . 29
cable requirements . . . 238
changed parameters mode . . . 29
clock set . . . 32
comm error, fault parameter . . . 96
contrast . . . 22
display contrast . . . 22
display decimal point (form), parameters . . . 104
display max., parameters . . . 105
display min., parameters . . . 105
display process variables, parameter group 104
display selection, parameters . . . 104
display units, parameters . . . 105
features . . . 22
i/o settings mode . . . 34
modes . . . 25
operating the drive . . . 26
parameter editing . . . 23
parameter lock, parameter . . . 76
parameters mode . . . 26
pass code, parameter . . . 76
reference control, parameter . . . 63
signal max., parameters . . . 104
signal min., parameters . . . 104
soft keys . . . 22
start-up assistant . . . 23
start-up assistant mode . . . 27
status information . . . 25
control panel (assistant)
battery . . . 224
control word
ABB drives, FBA, description . . . 203
comm (EFB), description . . . 162
FBA . . . 194
FBA generic profile . . . 210
cooling . . . 240
fan maintenance triggers . . . 95
correction source (PID), parameter . . . 124
cover
remove . . . 11
replace . . . 18
CRC errors (count), parameter . . . 127
critical speeds (avoiding)
high, parameters . . . 92
low, parameters . . . 92
parameter group . . . 92
select, parameter . . . 92
C-Tick marking . . . 246
current
at fault, history parameter . . . 60
data parameter . . . 53
max. limit, parameter . . . 83
measurement, fault code . . . 215
rating code . . . 9

## D

DC brake time, parameter . . . 86
DC bus voltage, data parameter . . . 53
DC current ref., parameter . . . 86
dc high rush, fault code . . . 215
DC magnetizing time, parameter . . . 86

DC overvoltage, fault code . . . . . 213
DC undervoltage, fault code . . . . . 214
DDL file (N2) . . . . . 176
deceleration
at aux. start (PFA), parameter. . . . . 141
emergency time, parameter . . . . . 89
parameter group . . . . . 88
ramp select, parameter . . . . . 88
ramp shape, parameter. . . . . 88
ramp time (PFA), parameter . . . . . 141
ramp zero select, parameter . . . . . 89
time, parameter. . . . . 88
default macro. . . . . 37
derating
altitude. . . . . 227
single phase supply. . . . . 227
switching frequency. . . . . 227
temperature. . . . . 227
derivation time (PID), parameter . . . . . 116
derivation time, parameter. . . . . 90
device overtemperature, fault code . . . . . 213
device type (N2) . . . . . 173
diagnostics. . . . . 212
EFB comm . . . . . 153
FBA comm . . . . . 201
digital cable
requirements . . . . . 238
digital input
at fault, history parameters . . . . . 60
connections. . . . . 239
specifications. . . . . 237
status, data parameter . . . . . 54
digital output
connections. . . . . 239
specifications. . . . . 237
dimensions
mounting . . . . . 242
outside, enclosure. . . . . 243
direction
control, parameter. . . . . 62
display format (PID), parameter . . . . . 116
drive
control terminal descriptions . . . . . 239
device type (N2) . . . . . 173
EFB comm installation . . . . . 145
FBA module installation . . . . . 196
id, fault code . . . . . 215
rating, parameter. . . . . 103
temperature, data parameter . . . . . 53
weight . . . . . 242
drive on time, data parameters . . . . . 55

## E

earth fault
fault code. . . . . 214
parameter . . . . . 98
earthing
see ground
efficiency . . . . . 240
embedded field bus
see comm (EFB)
EMC
CE marking. . . . . 246
C-Tick marking . . . . . 246
filter. . . . . 236
motor cable requirements. . . . . 234
emergency
deceleration time, parameter . . . . . 89
stop devices . . . . . 230
stop select, parameter . . . . . 87
enclosure protection class code . . . . . 9
encoder err, fault code . . . . . 215
environment
second, definition . . . . . 247
envoronment
first, definition . . . . . 247
error value inversion (PID), parameter . . . . . 116
exception codes, EFB modbus . . . . . 162
external comm module, parameter group . . . . . 125
external commands selection, parameter. . . . . 61
external control selection, parameter . . . . . 63
external fault
automatic reset, parameter . . . . . 100
fault codes . . . . . 214
parameters . . . . . 96
external reference, data parameter. . . . . 53

## F

fan maintenance . . . . . 222
fault
codes . . . . . 213
comm failure (EFB) . . . . . 151
comm (FBA) . . . . . 200
current at, history parameter . . . . . 60
digital input status at, history parameter. . . . . 60
frequency at, history parameter . . . . . 60
functions, parameter group . . . . . 96
history. . . . . 218
history, parameter group . . . . . 60
last, history parameter . . . . . 60
listing . . . . . 213
previous, history parameter . . . . . 60
reset . . . . . 217
reset select, parameter. . . . . 76
speed at, history parameter . . . . . 60
status at, history parameter . . . . . 60
time of, history parameters. . . . . 60
torque at, history parameter . . . . . 60
voltage at, history parameter . . . . . 60
words, data parameters . . . . . 58
fault code
28 serial 1 err . . . . . 154
features
N2 fieldbus . . . . . 171
feedback multiplier (PID), parameter . . . . . 119
feedback select (PID), parameter . . . . . 118
field weakening point . . . . . 232

fieldbus
see comm
command words, data parameters . . . . . 56
CPI firmware revision, parameter . . . . . 125
parameter refresh, parameter . . . . . 125
parameters . . . . . 125
status words, data parameters . . . . . 57
status, parameter . . . . . 125
type, parameter . . . . . 125
fieldbus adapter
see comm (FBA)
fieldbus termination . . . . . 240
filter, EMC/RFI . . . . . 236
firmware test date, parameter . . . . . 103
firmware version, parameter . . . . . 103
first environment, definition . . . . . 247
FLN fieldbus
also see comm (EFB)
description . . . . . 179
loop gains . . . . . 183
point database . . . . . 184
point descriptions . . . . . 187
reports . . . . . 179
supported features . . . . . 179
floating network
warning about filters . . . . . 236
warning about screws at EM1, EM3 . . . . . 14
warning about screws at F1, F2 . . . . . 15
flux braking, parameter . . . . . 93
flux optimization, parameter . . . . . 93
force trip, fault code . . . . . 215
frame errors (count), parameter . . . . . 127
frame size . . . . . 225
free fall
shipping limit . . . . . 245
frequency
at fault, history parameter . . . . . 60
max. limit, parameter . . . . . 84
min. limit, parameter . . . . . 84
motor, resolution . . . . . 232
motor, specification . . . . . 232
switching, parameter . . . . . 94
fuses . . . . . 228

## G

gain (PID), parameter . . . . . 115
generic profile
actual value mapping . . . . . 211
actual value scaling . . . . . 211
overview . . . . . 210
reference scaling . . . . . 210
technical data . . . . . 210
gland kit . . . . . 12
ground
cable/wire requirements . . . . . 231

## H

heat loss . . . . . 240

## I

id run fail, fault code . . . . . 214
IEC ratings
see ratings
incomp swtype, fault code . . . . . 215
information
parameter group . . . . . 103
input power
branch circuit protection . . . . . 228
cable/wire requirements . . . . . 230
fuses . . . . . 228
specifications . . . . . 228
input power connection
terminal size . . . . . 231
torque . . . . . 231
installation
compatibility . . . . . 9
environment . . . . . 10
flow chart . . . . . 7
location . . . . . 10
preparation . . . . . 8
procedures . . . . . 7
tools . . . . . 9
wiring . . . . . 12
integration time (PID), parameter . . . . . 116
integration time, parameter . . . . . 90
interlocks
parameter . . . . . 135
internal setpoint (PID), parameter . . . . . 118
IR compensation
frequency, parameter . . . . . 93
parameters . . . . . 93
voltage, parameter . . . . . 93

## K

keypad reference select, parameter . . . . . 63
kWh counter, data parameter . . . . . 53

## L

label
serial number . . . . . 8
type code . . . . . 8
language, parameter . . . . . 51
liability limits . . . . . 247
limits, parameter group . . . . . 83
load package version, parameter . . . . . 103
local mode
lock, parameter . . . . . 77
low frequency (PFA), parameters . . . . . 132

## M


macros
- booster pump . . . 42
- condenser . . . 41
- cooling tower fan . . . 40
- dual setpoint w/ PID . . . 47
- dual setpoint w/ PID & const. speeds . . . 48
- e-bypass . . . 49
- floating point . . . 46
- hand control . . . 50
- HVAC default . . . 37
- internal timer . . . 44
- internal timer w/constant speeds . . . 45
- listing . . . 35
- pump alternation . . . 43
- return fan . . . 39
- supply fan . . . 38
- to select . . . 36

mailbox, EFB comm . . . 152
mains
- see input power

maintenance
- capacitors . . . 223
- control panel . . . 224
- heat sink . . . 221
- internal enclosure fan . . . 223
- intervals . . . 221
- main fan . . . 222
- triggers, parameter group . . . 95

manuals . . . 2
mapping
- actual value, FBA, generic profile . . . 211
- EFB modbus . . . 156

materials . . . 245
maximum
- frequency, parameter . . . 84
- torque limit, parameters . . . 85
- torque select, parameter . . . 84

metasys
- connection diagram (companion) . . . 173
- connection diagram (system) . . . 172
- integration . . . 172

minimum
- frequency, parameter . . . 84
- torque limit, parameters . . . 85
- torque select, parameter . . . 84

modbus
- EFB addressing, convention . . . 157
- EFB coils . . . 157
- EFB discrete inputs . . . 158
- EFB holding registers . . . 160
- EFB input registers . . . 159
- EFB mapping details . . . 157
- EFB mapping summary . . . 156
- EFB supported features . . . 155
- EFB technical data . . . 155

motor
- aux. start delay (PFA), parameter . . . 132
- aux. stop delay (PFA), parameter . . . 132
- compatibility . . . 9
- connection specifications . . . 232
- control mode, parameter . . . 51
- id run, parameter . . . 52
- load curve break point frequency . . . 97
- load curve max., fault parameter . . . 97
- load curve zero speed load . . . 97
- maintenance triggers . . . 95
- nominal current, parameter . . . 52
- nominal frequency, parameter . . . 52
- nominal power, parameter . . . 52
- nominal speed, parameter . . . 52
- nominal voltage, parameter . . . 52
- number of aux., parameter . . . 133
- phase, fault code . . . 215
- stall, fault code . . . 214
- temperature alarm limit, parameter . . . 109
- temperature fault limit, parameter . . . 109
- temperature measure, parameter group . . . 107
- temperature sensor selection, parameter . . . 109
- temperature sensor type, parameter . . . 108
- temperature, data parameter . . . 55
- thermal protection, fault parameter . . . 96
- thermal time, fault parameter . . . 97

motor cable
- max. length . . . 232
- max. length, EMC . . . 236
- requirements . . . 233
- requirements, EMC . . . 234

motor connection
- terminal size . . . 231
- torque . . . 231

motor control
- IR compensation, parameters . . . 93
- parameter group . . . 93

motor temperature
- overtemperature, fault code . . . 214

MWh counter, data parameter . . . 55


## N


N2 fieldbus
- also see comm (EFB)
- description . . . 170
- node limit . . . 173
- supported features . . . 171

NCU
- see network control unit

NEMA ratings
- see ratings

network control unit
- description . . . 170
- N2 DDL file . . . 176

NPN . . . 240


## O


object
- virtual, description . . . 171

offset (PID), parameter . . . 123
ok messages (count), parameter . . . 127

operating data, parameter group . . . . . 53
OPEX link, fault code . . . . . 215
OPEX power, fault code . . . . . 215
options, parameter group . . . . . 142
output frequency, data parameter . . . . . 53
output voltage, data parameter . . . . . 53
output wiring
fault code . . . . . 215
overcurrent
automatic reset, parameter . . . . . 100
fault code . . . . . 213
overload, fault code . . . . . 214
overspeed, fault code . . . . . 215

## P

panel display variables, parameter group . . . . . 104
panel loss, fault code . . . . . 214
par override pars, fault code . . . . . 217
par pfa override, fault code . . . . . 217
parameter
analog input scale, fault code . . . . . 216
analog output scale, fault code . . . . . 216
change lock . . . . . 76
external relay output, fault code . . . . . 217
fieldbus, fault code . . . . . 217
hz rpm, fault code . . . . . 216
PCU 1 (power control unit), fault code . . . . 217
PCU 2 (power control unit), fault code . . . . 216
PFC IO config, fault code . . . . . 216
PFC mode, fault code . . . . . 217
PFC ref. neg., fault code . . . . . 216
save changes, parameter . . . . . 77
parameters
editing . . . . . 23
view changes . . . . . 29
parity errors (count), parameter . . . . . 127
parity (RS232), parameter . . . . . 127
PE earth
earth fault, parameter . . . . . 98
PE earth connection
terminal size . . . . . 231
torque . . . . . 231
PFA
acceleration time, parameter . . . . . 140
aux. motor start delay, parameter . . . . . 132
aux. motor stop delay, parameter . . . . . 132
control, parameter group . . . . . 130
deceleration time, parameter . . . . . 141
enable, parameter . . . . . 140
low frequency, parameters . . . . . 132
number of aux. motors, parameter . . . . . 133
reference step, parameters . . . . . 130
start delay, parameter . . . . . 140
start frequency, parameters . . . . . 131
PFC (pump fan control)
see PFA (pump fan alternation)
PID
0% (actual signal), parameter . . . . . 117
100% (actual signal), parameter . . . . . 117
actual input select, parameters . . . . . 119
actual value max., parameters . . . . . 119
actual value min., parameters . . . . . 119
adjustment procedure . . . . . 115
correction source, parameter . . . . . 124
decimal point (actual signal), parameter . . . 116
derivation filter, parameter . . . . . 116
derivation time, parameter . . . . . 116
deviation, data parameter . . . . . 55
error feedback inversion, parameter . . . . . 116
external source activate, parameter . . . . . 123
external / trimming, parameter group . . . . . 123
feedback multiplier, parameter . . . . . 119
feedback select, parameter . . . . . 118
feedback, data parameter . . . . . 54
gain, parameter . . . . . 115
integration time, parameter . . . . . 116
internal setpoint, parameter . . . . . 118
offset, parameter . . . . . 123
output, data parameter . . . . . 54
parameter set select, parameter . . . . . 121
process sets, parameter groups . . . . . 114
scaling (0%...100%), parameters . . . . . 117
setpoint maximum, parameter . . . . . 118
setpoint minimum, parameter . . . . . 118
setpoint select, parameter . . . . . 117
setpoint source, EFB comm activate . . . . . 150
setpoint source, FBA comm, activate . . . . . 200
setpoint, data parameter . . . . . 54
sleep delay, parameter . . . . . 120
sleep level, parameter . . . . . 120
sleep selection, parameter . . . . . 120
trim mode, parameter . . . . . 123
trim scale, parameter . . . . . 123
units (actual signal), parameter . . . . . 116
wake-up delay, parameter . . . . . 121
wake-up deviation, parameter . . . . . 121
PID controller
advanced set-up . . . . . 115
basic set-up . . . . . 114
planning
EFB comm . . . . . 144
FBA comm . . . . . 195
PNP . . . . . 240
power
data parameter . . . . . 53
first applied . . . . . 19
previous faults, history parameters . . . . . 60
process PID sets, parameter groups . . . . . 114
process variables, data parameter . . . . . 55
profiles
comm (EFB) . . . . . 156
proportional gain, parameter . . . . . 90
protection
branch circuit . . . . . 228
enclosure standard . . . . . 245
environmental . . . . . 244
PT100 temperature sensor . . . . . 108
PTC temperature sensor . . . . . 108

## R


ramp pair (accel/decel), parameter . . . . . 88
ratings . . . . . 225
reference
  analog input corrections . . . . . 65
  corrections for parameter values. . . . . 65
  keypad control, parameter . . . . . 63
  maximum, parameters . . . . . 65
  minimum, parameters . . . . . 65
  select source, parameter. . . . . 64
  select, parameter group . . . . . 63
reference scaling
  EFB, ABB drives profile. . . . . 168
  FBA, ABB drives profile. . . . . 207
  FBA, generic profile. . . . . 210
reference step (PFA), parameters . . . . . 130
regulator by-pass control, parameter. . . . . 139
relative humidity
  environment limit. . . . . 244
  shipping limit . . . . . 244
relay output
  activation condition parameters . . . . . 71
  off-delay, parameters . . . . . 72
  on-delay, parameters . . . . . 72
  parameter group . . . . . 71
  status, data parameter . . . . . 54
relays, specifications . . . . . 237
remove cover. . . . . 11
reports, FLN fieldbus . . . . . 179
reset, automatic
  analog input less than min., parameter. . . . 100
  delay time, parameter . . . . . 100
  external fault, parameter. . . . . 100
  number of trials, parameter. . . . . 100
  overcurrent, parameter . . . . . 100
  parameter group
  trial time, parameter . . . . . 100
  undervoltage, parameter. . . . . 100
resonance (avoiding)
  select, parameter . . . . . 92
revolution counter, data parameter . . . . . 55
RFI filter. . . . . 236
RS232
  baud rate, parameter. . . . . 127
  panel, parameter group. . . . . 127
  parity, parameter. . . . . 127
  station id, parameter . . . . . 127
RS232 counts
  buffer overruns, parameter . . . . . 127
  CRC errors, parameter . . . . . 127
  frame errors, parameter . . . . . 127
  ok messages, parameter. . . . . 127
  parity errors, parameter. . . . . 127
RS485 . . . . . 240
RS485 comm. . . . . 145
run enable
  source select, parameter. . . . . 76
run time, data parameter . . . . . 53, 55


## S


safety. . . . . 3
scalar control mode. . . . . 51
scaling
  actual values, EFB comm. . . . . 152
  actual value, FBA, ABB drives profile. . . . . 209
  actual value, FBA, generic profile. . . . . 211
  FLN actual values. . . . . 182
  reference (EFB, ABB drives profile) . . . . . 168
  reference, FBA, ABB drives profile. . . . . 207
  reference, FBA, generic profile. . . . . 210
s-curve ramp, parameter. . . . . 88
sensor type, parameter. . . . . 108
sensorless vector control mode . . . . . 51
serial 1 error (fault code 28) . . . . . 154
serial 1 error, fault code . . . . . 215
serial communication
  see comm
serial number . . . . . 8
setpoint maximum (PID), parameter. . . . . 118
setpoint minimum (PID), parameter . . . . . 118
setpoint select (PID), parameter. . . . . 117
shock
  shipping limit. . . . . 244
short circuit, fault code . . . . . 213
single phase supply
  derating . . . . . 227
sleep selection (PID), parameter . . . . . 120
slip compensation ratio, parameter. . . . . 94
soft keys, control panel. . . . . 22
specifications
  control connections . . . . . 237
  cooling . . . . . 240
  input power. . . . . 228
  mains . . . . . 228
  motor connections . . . . . 232
speed
  at fault, history parameter. . . . . 60
  data parameter. . . . . 53
  max. limit, parameter . . . . . 83
  min. limit, parameter. . . . . 83
speed control
  acceleration compensation, parameter . . . . . 91
  automatic tuning, parameter. . . . . 91
  derivation time, parameter . . . . . 90
  integration time, parameter . . . . . 90
  parameter group. . . . . 90
  proportional gain, parameter . . . . . 90
speed, constant
  digital input selection parameter. . . . . 67
  parameter. . . . . 69
  parameter group. . . . . 67
stall
  frequency, fault parameter . . . . . 98
  function, fault parameter. . . . . 98
  region . . . . . 98
  time, fault parameter . . . . . 98

standards . . . 245
CE marking . . . 246
CSA marking . . . 246
C-Tick marking . . . 246
EN 50178 . . . 245
EN 60204-1 . . . 245
EN 60529 . . . 245
EN 61800-3 . . . 245, 247
IEC 60664-1 . . . 245
UL 508C . . . 245
UL marking . . . 246
start
aux. motor delay . . . 132
aux. motor (PFA), parameters . . . 131
control, EFB comm . . . 147
control, FBA comm . . . 197
DC magnetizing time, parameter . . . 86
delay (PFA), parameter . . . 140
frequency (PFA), parameters . . . 131
function, parameter . . . 86
inhibit, parameter . . . 87
parameter group . . . 86
torque boost current, parameter . . . 87
start mode
automatic . . . 86
automatic torque boost . . . 86
DC magnetizing . . . 86
flying start . . . 86
starting order counter . . . 135
start-up
macros . . . 20
motor data . . . 20
tuning . . . 21
start-up assistant . . . 23
start-up data, parameter group . . . 51
start/stop, parameter group . . . 86
start/stop/dir, parameter group . . . 61
state diagram
comm (EFB) . . . 167
comm, ABB drives . . . 206
station id (RS232), parameter . . . 127
status at fault, history parameter . . . 60
status word
ABB drives, FBA, description . . . 204
comm (EFB), definition . . . 164
FBA . . . 195
FBA generic profile . . . 210
stop
aux. motor delay . . . 132
aux. motor (PFA), parameters . . . 132
DC brake time, parameter . . . 86
DC current ref., parameter . . . 86
emergency devices . . . 230
emergency select, parameter . . . 87
flux braking, parameter . . . 93
function, parameter . . . 86
parameter group . . . 86
supervision
parameter group . . . 101
parameter low limit, parameters . . . 101
parameter selection, parameters . . . 101
supply phase, fault code . . . 215
switching frequency . . . 232
switching frequency control, parameter . . . 94
switching frequency derating . . . 227
switching frequency, parameter . . . 94
system controls, parameter group . . . 76

## T

temperature derating . . . 227
termination . . . 145
test date, parameter . . . 103
thermal fail, fault code . . . 215
timers
boost . . . 112
enable . . . 111
parameter group . . . 110
source . . . 113
start/stop time . . . 111
tools . . . 9
torque
at fault, history parameter . . . 60
boost current, parameter . . . 87
data parameter . . . 53
max. limit select, parameter . . . 84
max. limit, parameter . . . 85
min. limit select, parameter . . . 84
min. limit, parameters . . . 85
trim mode (PID), parameter . . . 123
trim scale (PID), parameter . . . 123
type code . . . 8

## U

UL/CSA markings . . . 246
underload
curve, fault parameter . . . 98
fault code . . . 214
function, fault parameter . . . 98
time, fault parameter . . . 98
undervoltage
automatic reset, parameter . . . 100
control enable, parameter . . . 83
units (PID), parameter . . . 116
user parameter set
change control, parameter . . . 77
U/f ratio, parameter . . . 93

## V

vibration
environment limit . . . 244
shipping limit . . . 244
virtual object, N2 . . . 171
VND . . . 173
voltage
at fault, history parameter . . . 60
rating code . . . 9
voltage/frequency ratio, parameter . . . 93

## W

wake-up delay (PID), parameter . . . 121
wake-up deviation (PID), parameter . . . 121

warning
automatic start up . . . . . 3, 19
dangerous voltages . . . . . 3
high temperatures . . . . . 3
listing . . . . . 3
not field repairable . . . . . 3
parallel control connections . . . . . 3
qualified installer . . . . . 3
weight . . . . . 242
wiring
installation . . . . . 12

## XYZ

zero speed load, fault parameter . . . . . 97

ACH550-US-04
3AUA0000004092 Rev B / EN
EFFECTIVE: Mar. 1, 2004
SUPERSEDES: Nov. 26, 2003

**ABB Oy**
AC Drives
P.O. Box 184
FIN-00381 HELSINKI
FINLAND
Telephone +358 10 22 11
Telefax +358 10 22 22681
Internet http://www.abb.com

**ABB Inc.**
Automation Technologies
Drives & Machines
16250 West Glendale Drive
New Berlin, WI 53151
USA
Telephone 262 785-3200
800 HELP-365
Telefax 262 780-5135